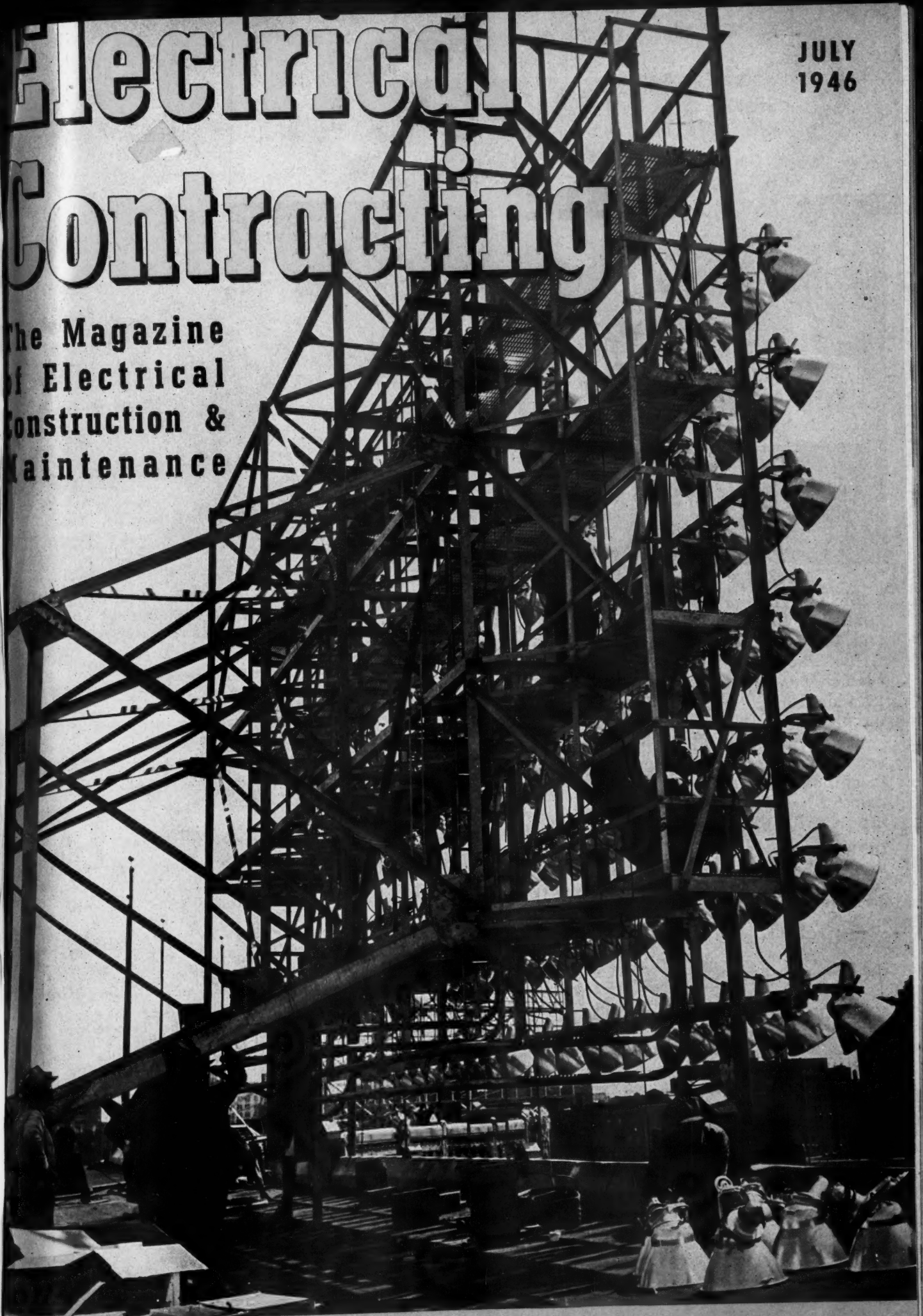
# Electrical Contracting

JULY
1946

The Magazine
of Electrical
Construction &
Maintenance



FLOODLIGHTING YANKEE STADIUM

# FLAMENOL CABLE

## for wiring that's EASY TO IDENTIFY — HARD TO HURT

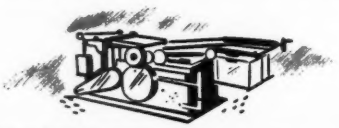
Electric circuits on machines, panelboards, control devices and the like are easily traced and identified when wired with Flamenol Cable. The smooth, impervious insulation of Flamenol *stays* bright and clean. Seven colors provide for permanent coding of complex circuits.

Once wired with Flamenol, electric circuits are well protected for the full life-span of the machine. All the usual causes of insulation damage have little if any effect on the insulation of Flamenol, as these actual cases show:

***OIL WON'T HURT IT***—In a chemical process plant, leads to oil-immersed motor controls were a constant source of trouble, until rewired with Flamenol. They've never given trouble since.

***MILD ACIDS AND ALKALIES WON'T HURT IT***—Used to wire a battery-charging set-up, Flamenol didn't fail despite "dunking" with electrolyte. In paper-mill wiring, it stood up against alkalies.

***SOLVENTS WON'T HURT IT***—Flamenol ended wiring troubles on printing presses where inks splashed on the wiring.



***MOISTURE WON'T HURT IT***—After 7 years underground in damp soil, Flamenol insulation was still impervious.

***AGE WON'T HURT IT***—In a seven-year test under Florida sunlight, the insulation on Flamenol cable showed no signs of deterioration.

### *ANOTHER G-E ACHIEVEMENT RESULTING FROM "FULL-RANGE" RESEARCH*

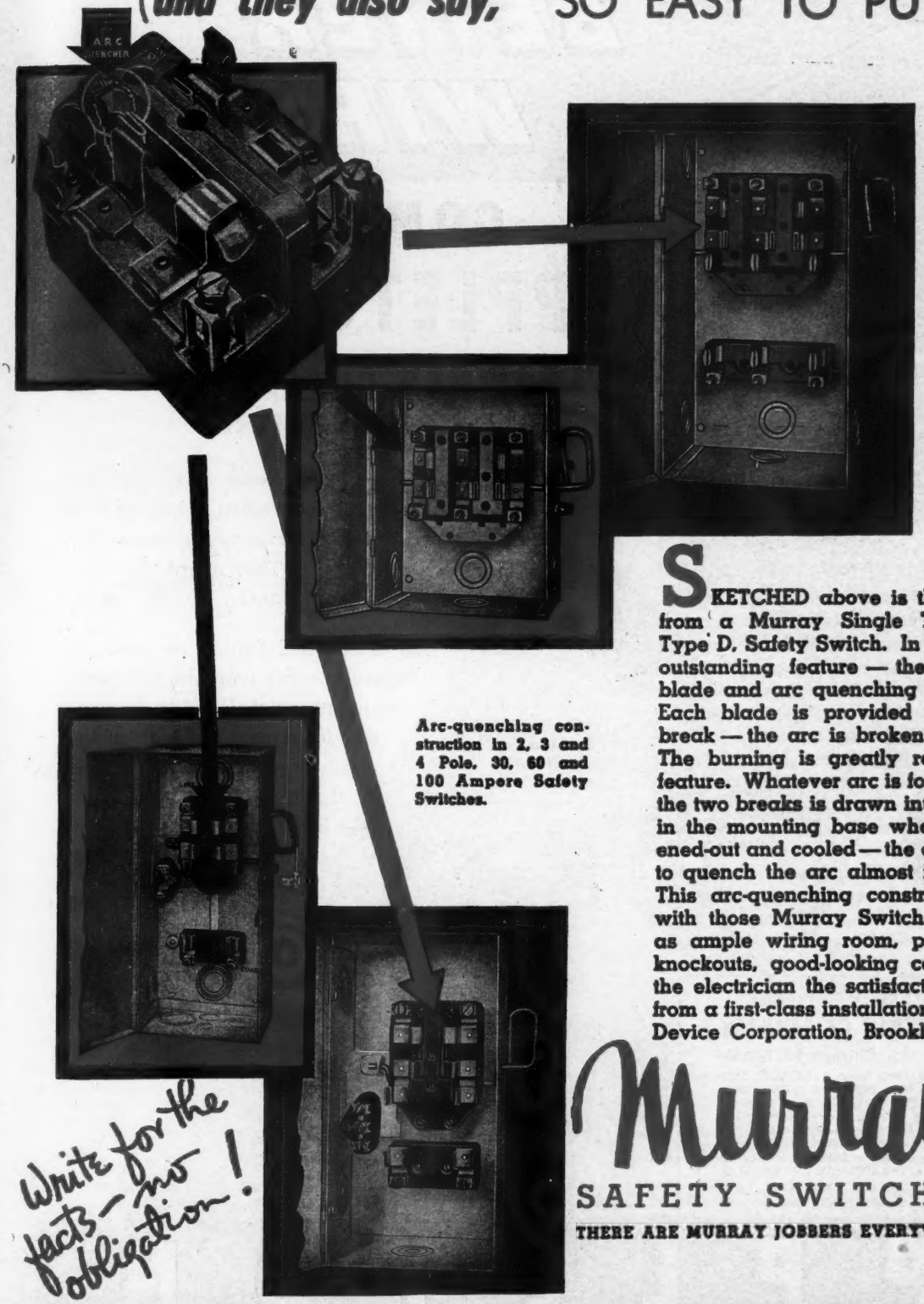
**Long before the rubber shortage, G.E. had been seeking a "better-than-rubber" insulation for low-voltage wire and cable; an insulation that would be slow to age, hard to burn, and able to resist acids, oils, water, and alkalies. Soon, chemists in the G-E laboratories produced such an insulation from plasticized polyvinyl chloride. G-E process engineers then took the new insulation, and prior to 1936 had solved the problem of its application to a conductor on a practical basis. The result was Flamenol, the first wire and cable to be insulated with long-lived, tough, plasticized polyvinyl chloride—another G-E first.** ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

**GENERAL ELECTRIC**

502-58-1200

# "A FIRST CLASS INSTALLATION", *say electricians*

## *(and they also say,* "SO EASY TO PUT IN")




**Arc-quenching construction in 2, 3 and 4 Pole, 30, 60 and 100 Ampere Safety Switches.**

**SKETCHED above is the switch block from a Murray Single Throw, Fusible, Type D, Safety Switch. In the circle is the outstanding feature — the double break blade and arc quenching chamber.**

**Each blade is provided with a double break — the arc is broken into two parts. The burning is greatly reduced by this feature. Whatever arc is formed at each of the two breaks is drawn into a narrow slot in the mounting base where it is lengthened-out and cooled — the effects co-acting to quench the arc almost instantly.**

**This arc-quenching construction coupled with those Murray Switch characteristics as ample wiring room, properly placed knockouts, good-looking cabinets, assure the electrician the satisfaction that comes from a first-class installation. Metropolitan Device Corporation, Brooklyn, New York.**

*Write for the facts — no obligation!*

**Murray**

**SAFETY SWITCHES**

**THERE ARE MURRAY JOBBERS EVERYWHERE**



ELECTRICAL CONTRACTING. Published monthly, price 35 cents a copy. Vol. 45, No. 7. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication Office, 99-129 N. Broadway, Albany 1, N. Y. All communications about subscriptions should be addressed to the Vice-President (for Circulation Operations), Electrical Contracting, 330 West 42nd St., New York 18, N. Y. Subscrition Rates—U. S. and possessions, Mexico, Central and South American Republics, $3.00 a year, $4.00 for two years, $5.00 for three years. Canada $3.50 a year, $5.00 for two years, $6.00 for three years. All other countries $5.00 a year, $10.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second-class matter August 29, 1936, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S.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# STANDARD for BETTER WIRING

Square and Octagonal Outlet Boxes in various sizes, with a wide selection of covers. Also Switch Boxes of every type and size.

## COMPLETE APPLETON LINE

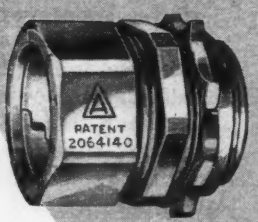
### Answers *Every* Wiring Requirement

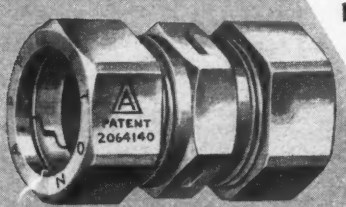
● Outstanding in completeness—the Appleton line of over 15,000 items offers a size and type of electrical fitting for every preference and specification! . . . That means time-saving, easy installations!

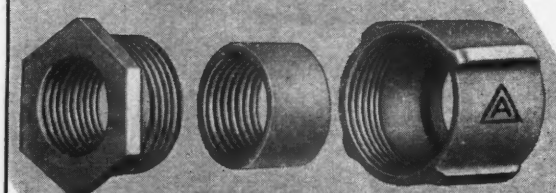
All fittings and fixtures are made in Appleton's own foundries and fabrication plants, designed to the most exacting standards of high quality and rugged dependability — they'll last the life of the building! That means money-saving, efficient operation!

Fittings and Connectors, threaded or no-thread, in various types and sizes, for every entrance requirement, including REA cable accessories.

Send for the big Appleton Catalog, with complete descriptions of 15,000 items.



Couplings, Connectors and Fittings of every size and type for electrical metalic tubing, rigid conduit, flexible conduit, or armored cable.

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*Sold Through Electrical Wholesalers*

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

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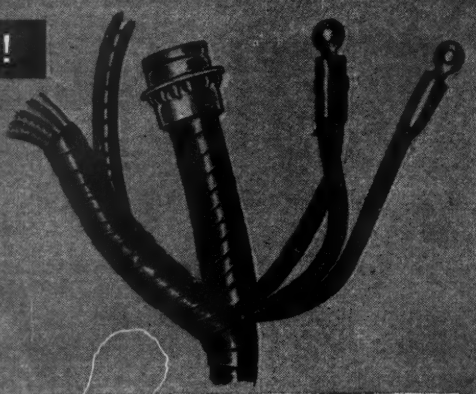
# ELECTRICAL INSULATION NEWS

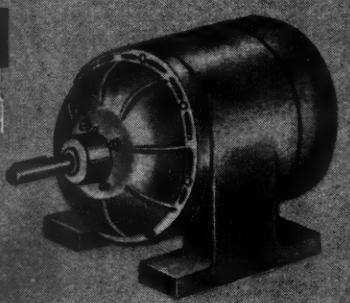
## FROM INSULATION HEADQUARTERS

### NEW USE FOR PLASTIC TAPE!



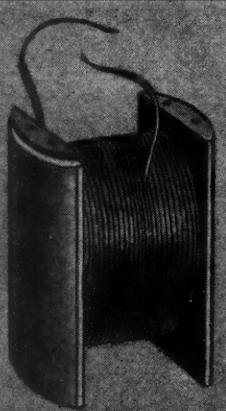
Irvington Fibron Plastic Tape is a "natural" for wrapping intricate, many-branched wire harnesses. Flexible and elastic, it wraps smoothly and evenly over irregular surfaces and will not bulk in sharp corners. Fibron Plastic Tape is tough — having superior abrasion resistance, excellent weathering qualities, high resistance to oils, acids, and alkalis. After wrapping, the harness can be heat-sealed, forming a homogeneous mass of insulation.

### SILICONE IS HERE!



Irvington Silicone-coated Fiberglas cloth — totally inorganic flexible insulation — can be used at operating temperatures up to 175 deg. C. It is highly moisture resistant and has excellent dielectric strength. The best heat resistant flexible insulation yet developed, Silicone-coated Fiberglas is added protection against overload failures. Available: 36" wide, tapes, and bias strips.

### SILK NOW AVAILABLE!



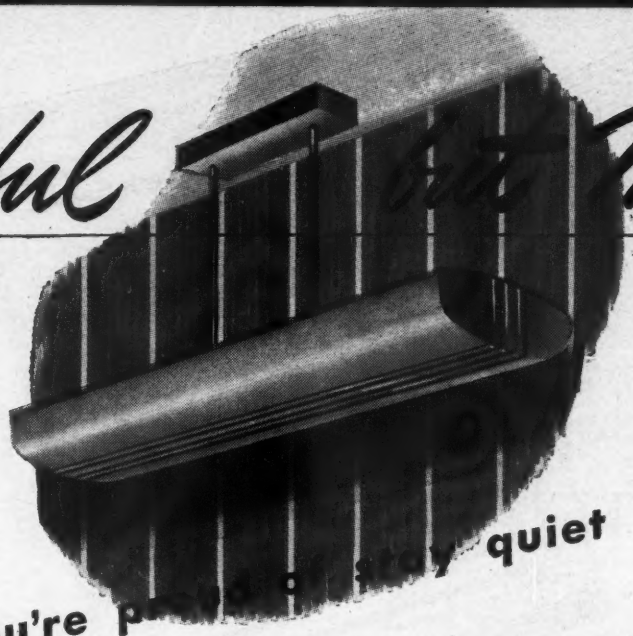
Immediate deliveries can be made on Irvington Varnished Silk *for any application.* Combining high dielectric strength, excellent oil and water resistance with extreme thinness and elasticity, its return will be welcomed for insulating very small coils and for taping over irregular surfaces.

Additional Information and Generous Samples of these Products will be sent on Request.

**IRVINGTON** *Varnish and Insulator Company*

IRVINGTON 11, NEW JERSEY, U.S.A.

# Beautiful ... Mum!



## The fixtures you're p... ...y quiet when they're built with G-E BALLASTS

Your newest fixtures are something to be proud of. Their smooth-flowing lines will please any customer's eye. But can you be sure that annoying ballast hum won't assault his ear?

G-E ballasts are designed to solve this problem by keeping fluorescent fixture noise at practically inaudible levels. They will give years of the quiet service that is so important for concentration during working hours, for peace of mind in leisure moments, and for the customer satisfaction that means increased sales.

**QUIETNESS IS BUILT-IN**

G-E ballasts are quiet because the quality of the materials and workmanship that go into their manufacture is *controlled* every step of the way. Coils are machine wound for exact dimensions and sealed against vibration with a special clamping and compounding to assure long life and a uniform degree of quiet operation in every G-E ballast you buy.

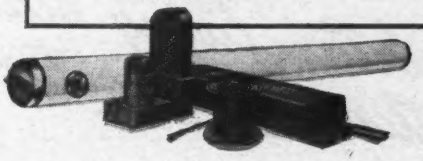
Cores are of low-loss steel, precisely stamped and stacked. Case and frame are designed to help you wire and mount quickly and easily. Every detail of construction is planned to help give better performance. It is these plus values of G-E ballasts that make them so popular with fixture manufacturers.

For more complete information get in touch with your nearest G-E office, or write to us direct. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

*General Electric ballasts help keep fixture users satisfied...they mean Added Profits for You!*

1. Low noise level—for satisfied users
2. Long life—for low replacement cost
3. Characteristics matched with lamp —for rated lamp life and light output

**BALLASTS • LAMPS • STARTERS**
**LAMPHOLDERS • CABLE**
*For DEPENDABILITY in fluorescent lighting*



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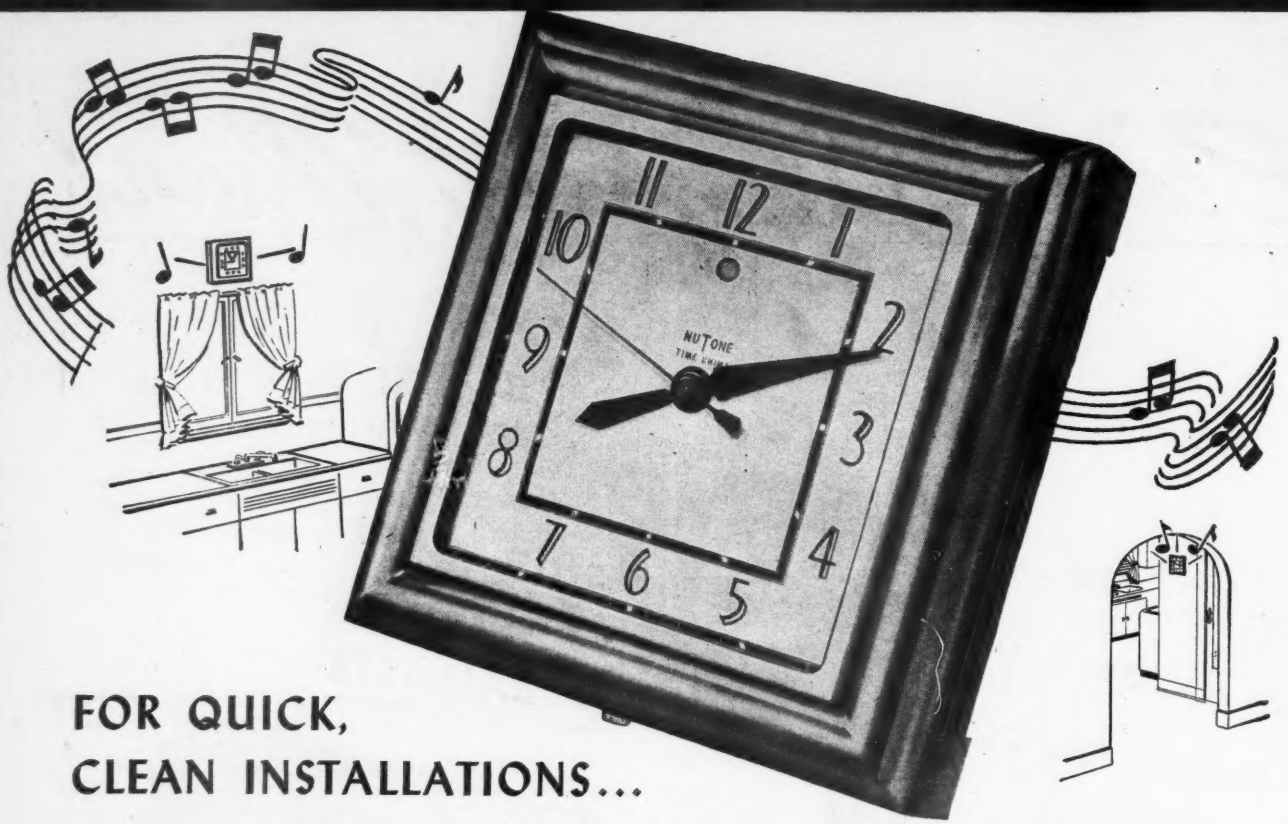



## FOR QUICK, CLEAN INSTALLATIONS...

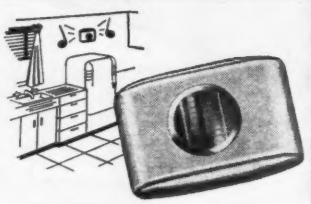
# *plan your* NuTone *Time-Chime wiring NOW!*

Built-in chime wiring is appreciated. It's evidence of careful planning. It saves time in the long run. Gives you quick, clean installations. No chipped paint, no marred woodwork. Costs less, too.

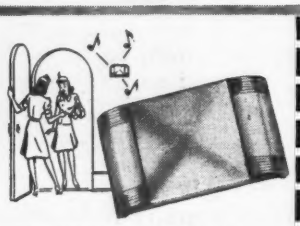
So plan NOW for wiring the NuTone Time-Chime . . . the fine new 2-door chime and *Telechron* electric clock that lists at $14.95.

Experience has shown that a height of six or seven feet is ideal for mounting the Time-Chime in the kitchen or hallway. Before the war, one large Long Island building development successfully used a niche in the kitchen for an earlier-model NuTone Time-Chime.

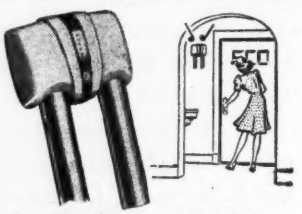
Complete wiring directions and suggested installation sites for this chime are yours for the asking. Write your nearest NuTone office. *NuTone Incorporated, Merchandise Mart, Chicago 54; 200 Fifth Ave., New York 10; 931 E. 31st St., Los Angeles 11; or Terminal Sales Bldg., Seattle 1.*



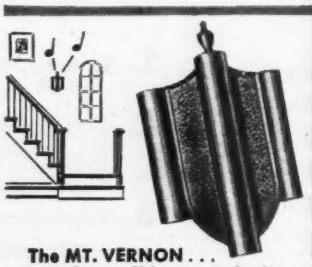
**The LEADER . . .** for kitchens, hallways, or as a second-floor auxiliary chime in large homes. A 2-door chime. List, $3.50.



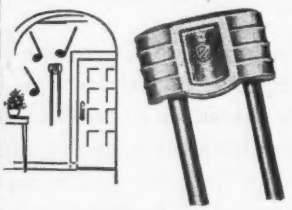
**The SKYLINE . . .** for kitchen or hallway walls. Mount slightly above eye level for best results. A 2-door chime. List, $4.95.



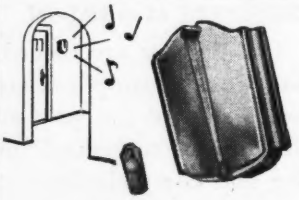
**The DE LUXE . . .** a short-tube model in kitchen or hallway colors. Two tones for front door, one for rear. List, $6.95.



**The MT. VERNON . . .** a 2-door all-brass Colonial chime for stairway, hallway, or living-room installation. List, $7.95.



**The IMPERIAL . . .** a 2-door, long-tube chime (38¼" overall), well suited for foyer or living-room niche mounting. List, $7.95.



**The JEWEL . . .** modern all-brass 2-door chime for living room or hallway. Packed with matching Jewel Push Button. List, $9.95.

*. . . better living means better listening, too!*

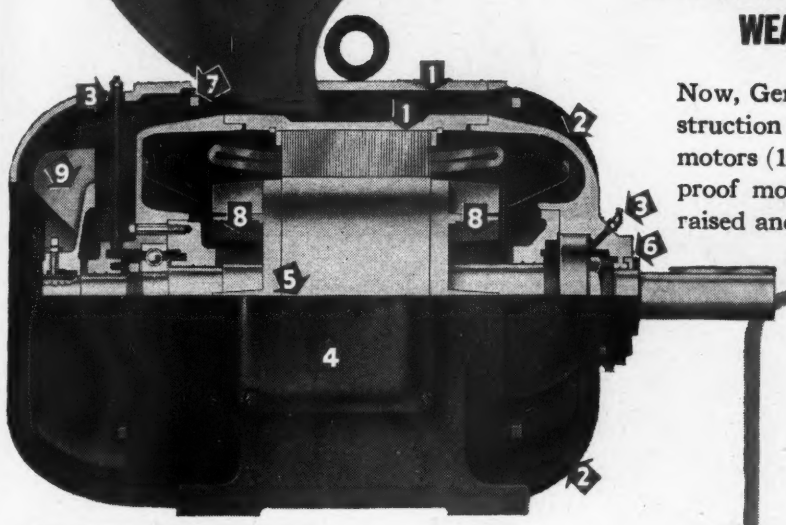
NUTONE
TRADE MARK

**WORLD'S LARGEST MAKER OF DOOR CHIMES**

# DOUBLE WALL *Keeps trouble out*

## NEW *TRI/CLAD* TOTALLY ENCLOSED MOTOR IS MORE FULLY PROTECTED FROM DUST, DIRT, WEATHER, OR WHAT-HAVE-YOU . . .

Now, General Electric has applied Tri-Clad construction to its line of totally enclosed induction motors (1 to 1000 hp) and to most of its explosion-proof motors as well. *Extra protection* has been raised another notch.




### *FOR EXTRA-SEVERE JOBS*

Applications amid dust, metal filings, coolants, or corrosive agents, where totally enclosed motors have always been required, will now have the benefit of a stronger armor, plus convenience features that simplify installation and servicing.

### *FOR EXTRA-WET LOCATIONS*

Indoors or out, these Tri-Clad totally enclosed motors will take hosings or heavy rains without danger of shutdown. The cast-iron frame is strongly resistant to rust and corrosion.

### *FOR EXTRA LONG LIFE*

Many motor users are making the totally enclosed motor their standard for *all* jobs—based on evidence of long-term savings. This new member of the Tri-Clad line makes this decision more logical than ever.

### *HAZARDOUS ATMOSPHERES*

"Companion motors" to the standard Tri-Clad totally enclosed, the new explosion-proof and dust-explosion-proof types are tested and listed by Underwriters' Laboratories for Class I Groups C and D, and Class II Group E, F, and G.

## THESE 9 POINTS

**of new strength and serviceability put this Tri-Clad totally enclosed motor way ahead**

**1.** A cast-iron, double-wall frame that completely encloses windings and punchings

**2.** Ribbed cast-iron end shields, machined to provide a tight seal, yet easily removed

**3.** Well proved pressure-relief greasing systems which can be packed with a long-life lubricant where advisable

**4.** Cast-iron conduit box diagonally split for wiring convenience (independently explosion-proof on explosion-proof motors)

**5.** Leads are sealed in a nonshrinking compound at the point where they emerge from frame

**6.** Rotating, labyrinth seal prevents infiltration of grit or liquids

**7.** Large, free-flowing, easy-to-clean air passages protect parts from accumulation of dust and foreign matter

**8.** Modern "ageless" insulation treatment includes Formex* magnet wire

**9.** Powerful external fan is removable, simplifying maintenance. (Nonsparking type for explosion-proof motors.)

AND IN ADDITION —compactness and short length promote ease of handling and installation.

*Trade-mark Reg. U.S. Pat. Off.

**GENERAL ELECTRIC**

750-257C-8058

**FOR THE COMPLETE STORY**

**GENERAL ELECTRIC COMPANY**
**Apparatus Dept., Schenectady 5, N. Y.**

*Please send me GEA-4400, which describes the new Tri-Clad totally enclosed motor.*

*Please send me GEA-4131, "Motors and Control for Hazardous Locations."*

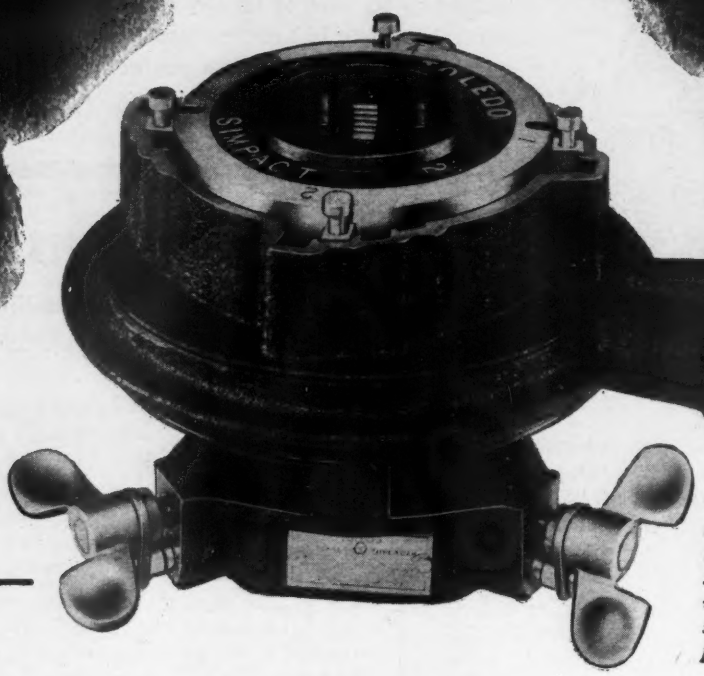
Name.....

Company.....

Address.....

3898

# A TOOL YOU CAN TRUST!




*Toledo SIMPACT—self-contained, adjustable threader for 1" to 2" pipe. Sizes changed instantly with one set high speed steel dies. Accurate, dependable.*

## BETTER THREADS . . . LOWER COSTS!

Wherever TOLEDO Pipe Tools are on the job—there's satisfaction!

For nearly half a century, experienced hands have relied on these easy-threading tools. They're engineered for accuracy . . . dependability . . . and time-saving operation. This assures better threads . . . lower costs . . . with TOLEDO efficiency!

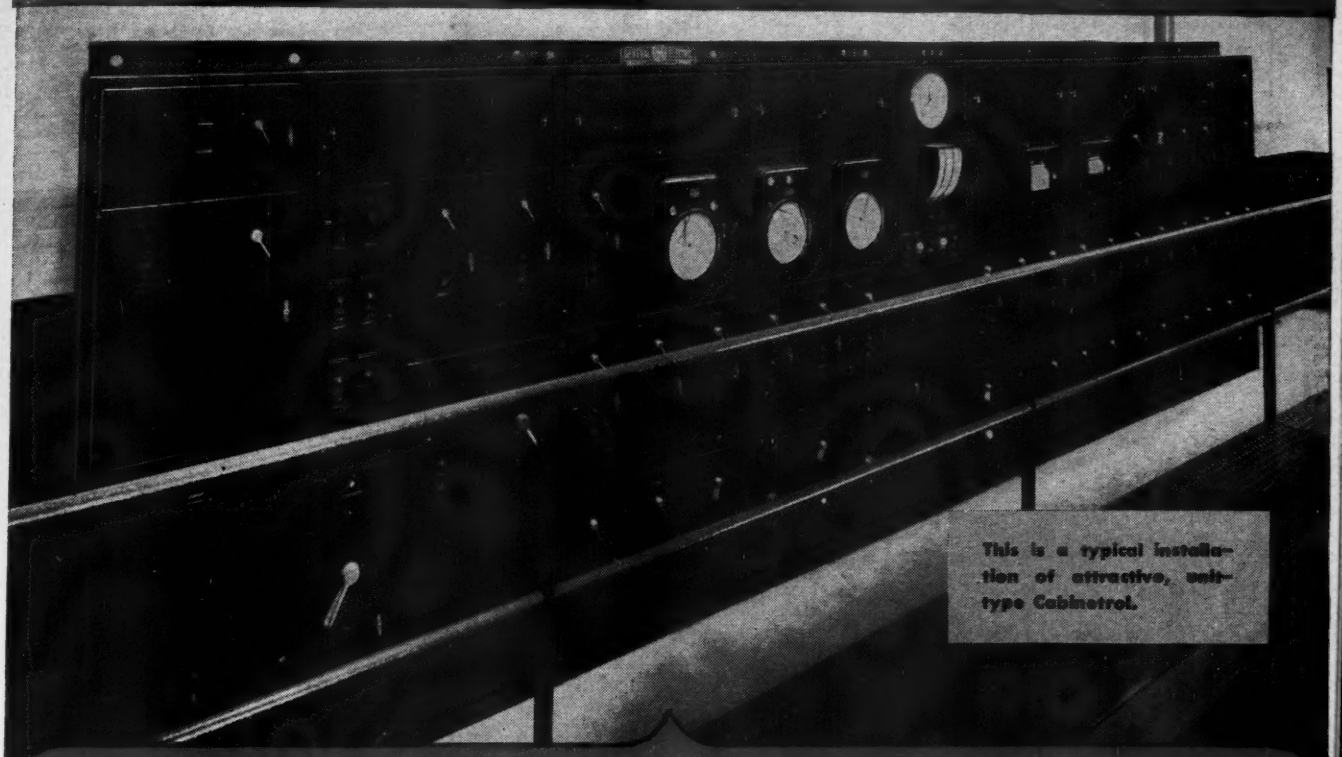
Today's urgent demands for new homes and new commercial and industrial building calls for the best in pipe tools. Specify TOLEDO—a tool you can trust! The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector Street Building.

**RELY ON THE LEADER . . .**

**TOLEDO**

**FOR PRECISION PIPE TOOLS**

# HODGE-PODGE CONTROL IS EXPENSIVE!



This is a typical installation of attractive, unit-type Cabinetrol.

## Trim, Modern CABINETROL Cuts Installation Time and Cost

Rambling, space-taking racks are a thing of the past. Control in the *modern* plant is compact, centralized G-E Cabinetrol. It's attractive in design, safe to operate, and it costs no more!

Cabinetrol saves installation time and expense because it's a single, self-supporting unit. No cumbersome frames—no cluttered walls. Just one attractive, all-metal unit that will greatly enhance the appearance of your mill.

The savings in installation cost that you get with Cabinetrol usually far outweigh its higher original cost. Only two operations are necessary—placing the unit in the designated location and connecting external power, motor, and control leads.

### IT'S PRE-ENGINEERED

Cabinetrol is based on the use of standard enclosures equipped with the right combination of standard control devices. Each unit is pre-engineered to meet your specific requirements. All starters and accessory equipment necessary to your application are incorporated in the Cabinetrol unit before it is shipped.

### PROTECTS YOUR OPERATORS

Because metal-enclosed Cabinetrol is completely deadfront, it offers your operators and servicemen maximum protection. Each motor control is installed in an individual sheet-steel compartment with an interlocking door. Operating mechanisms for motor-circuit switches and air circuit-breakers are available from the front of the panel.

**LET US HELP YOU** equip your plant with co-ordinated control. We'll be glad to work with you now—to provide a Cabinetrol system specially engineered for your plant—and, if you desire, to help you fit Cabinetrol into your over-all plans.

If you'd like more facts about Cabinetrol ask for Bulletin GEA-3856. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

**G-E INDUSTRIAL CONTROL**

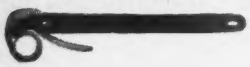
GENERAL ELECTRIC

## No pipe wrench housing repair expense with the guaranteed RIDGID

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free.
COPR. 1937
THE RIDGE TOOL CO.
ELYRIA, O.
TRADE RIDGID MARK

### Millions of users know the bother and money this RIDGID Guarantee saves them

● That revolutionary RIDGID housing has long since proved that you can't damage it in normal use... even the adjusting nut in its open position won't bind, always spins easily to pipe size, 6" to 60." Precision-cut alloy jaws take-hold and let-go instantly, won't lock. Handy pipe scale on hookjaw. Comfort-grip I-beam handle. For easier work and lowest possible upkeep expense... ask your Supply House for the RIDGID.

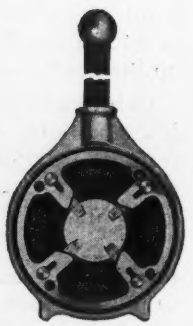


RIDGID *Strap Wrench*

## Thread 1" to 2" pipe fast and easily with this direct-action No. 1R RIDGID

**You'll like the mistake-proof quick-setting workholder...**

● Here's a poster threader that gives you new ease and speed in cutting clean threads on 1," 1¼," 1½" and 2" pipe. Workholder sets to size quickly: put on pipe, tighten 1 screw, no bushings. Full-floating posts only taper threads: positive wobble-proof threading action, handle to head to chasers. Alloy or high-speed steel dies, rugged steel-and-malleable construction for long service. It sells at a popular price, at your Supply House.



*1R stands up handily on its own feet.*

Millions of RIDGID Tools in use

★ RIDGID ★

WORK-SAVER PIPE TOOLS

The Ridge Tool Company
Elyria, Ohio, U. S. A.

# Buy the Best

## DRY-TYPE TRANSFORMER!

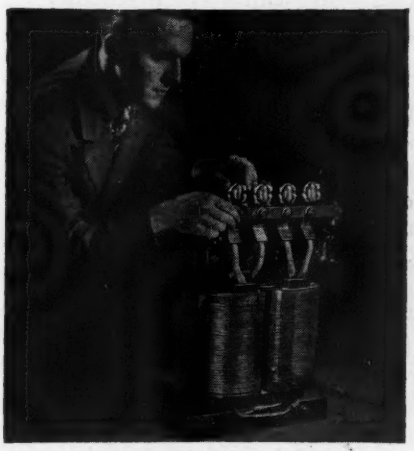
| FEATURES | Allis-Chalmers | Make "B" | Make "C" | Make "D" | Make "E" | Make "F" | Make "G" |
|---|---|---|---|---|---|---|---|
| Class "B" Insulation | YES | NO | YES | NO | NO | NO | NO |
| Light Weight, Compact | YES | NO | YES | NO | NO | NO | NO |
| Clamp Connectors | YES | NO | NO | NO | NO | NO | NO |
| Voltage Regulating Taps | YES | NO | YES | NO | NO | NO | NO |
| Conduit Knockouts | YES | YES | YES | YES | YES | YES | YES |
| Modern, Attractive Appearance | YES | NO | YES | YES | NO | NO | NO |
| Quiet Operation | YES | NO | YES | NO | NO | NO | NO |

**Compare leading makes. Only A-C's new Class "B" insulated units give you all 7 important features!**

Class "B" insulation in Allis-Chalmers new Dry-Type Transformers reduces overall size as much as 1/3 over conventional Class "A" insulated types — reduces weight 22 to 38% — means wider range of installation... enables you to locate power almost any place you want it!

These Class "B" insulated units require less mounting materials — eliminate insulating liquids and fireproof vaults — give longer service for no increase in cost over Class "A" insulated types... adding up to lower overall cost for you!

For complete details get in touch with your nearby Allis-Chalmers dealer or sales office, or send for new bulletin B6382. ALLIS-CHALMERS, MILWAUKEE. A 2081



**CLAMP** connectors are a standard feature of the new Allis-Chalmers transformer. Gives anchor point for connecting either 480 or 240 voltages on both high, low voltage sides — means easier, faster installation for you!

**SMALLER AND SAFER,** these new improved units are priced as low as comparable Class "A" insulated types. You can choose from 14 sizes ranging from 1½ to 200 kva, single-phase and 10 to 300 kva three-phase.

**ALLIS CHALMERS** — **DRY-TYPE TRANSFORMERS**

★ Both of the SANGAMO TIME SWITCHES shown here are equipped with Astronomic Dials.

# SANGAMO

## *Astronomic Dials*

## AUTOMATICALLY FOLLOW THE SUN'S SCHEDULE FOR TIMING . . .

SANGAMO TIME SWITCHES equipped with ASTRONOMIC DIALS are well worth their cost. They offer full automatic control and greatest flexibility for lighting applications.

After installations are made, the users do not have to change the dial manually. This means a considerable saving in periodic labor costs. Day after day the astronomic "on" and "off" arms automatically change their setting exactly to the rising and setting times of the sun. In addition, any of these dials permit of the "off" operation at any time between 9:30 P.M. and 2:15 A.M. Special schedules of operation may also be obtained.

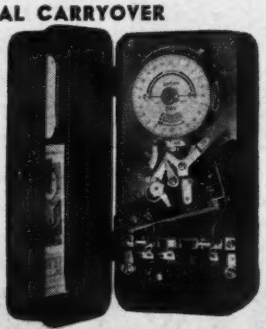
Practically all lighting installations for advertising purposes, general uses, and for protection require this dependable timing.

**FORM KAZ**
**SYNCHRONOUS MOTOR**
**WITH ASTRONOMIC DIAL**

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff.

**FORM VSWZ WITH**
**ASTRONOMIC DIAL CARRYOVER**

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of resetting the dial after current interruptions, and insures accurate timing under all conditions.



## CATALOG 1000 *Tells Details*

This latest SANGAMO TIME SWITCH catalog is fully informative and will be valuable to you in your sales work. There are eleven forms of SANGAMO TIME SWITCHES supplied with ASTRONOMIC DIALS which include outdoor types. Write for your free copy today and keep it handy for reference.

**SANGAMO ELECTRIC COMPANY** SPRINGFIELD ILLINOIS

# Costs Less in the Long Run

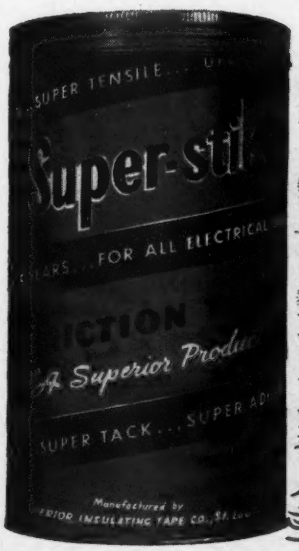
## Price Forgotten... *when a job's well done the first time*

Every wireman wants to avoid the trouble and delay that a faulty splice can cause him. He can save himself many hours of unnecessary drudgery . . . hours lost because he has to fish, resplice and feed the wire back again. When it's time to order tape, the one sure way he can avoid trouble is to specify *Super-stik friction tape*. It doesn't ravel, peel or curl. High tensile . . . its adhesive and tacky properties are great. It is clean to use . . . doesn't stick to the hands. The result of an entirely new laboratory formula, this Mintert calender-process tape meets all specifications. Ask any authorized electrical wholesaler for a sample.

**SUPERIOR INSULATING TAPE CO., ST. LOUIS, MO., U. S. A.**

*Established 1923*

***Write for a free "test-it-yourself" splice. Mailed without charge.***




PACKED 10 ROLLS TO THE CAN

# Super-stik

## FRICTION TAPE

*"Sticks to the End"*

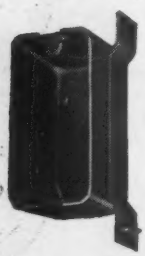
# "Betcha don't know who Raco is!"

Of course *they* don't know that Raco is a trade-marked line of All-Steel-Equip Company . . . a complete line of steel switch boxes and outlet boxes. The line that has won the approval of architects, builders and contractors throughout America.

## WHY YOU, TOO, CAN "RELY ON RACO"

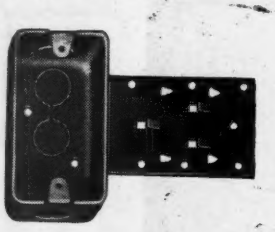
You can rely on Raco to be the clean line. No dirt or grease . . . keeps its smooth, attractive appearance! And Raco products are packaged. You can rely on each product coming neatly packed in protective cartons . . . with readable index showing number, quantity and finish.

You can also look for uniform standards. The same exacting standards are used as in other precision products that All-Steel has been manufacturing for more than 33 years. Remember, the Raco • All-Steel line is *sold nationally through wholesalers only.* Look for the Raco trade-mark . . . it signifies the quality line, the line you can "rely on."



←400½-O—STANDARD (UTILITY) BOX. *With "Side-Mount" Bracket. Enameled or galvanized finish.*

400½-B—STANDARD (UTILITY) BOX. *With "Face-Mount" Bracket. Enameled or galvanized finish.*→

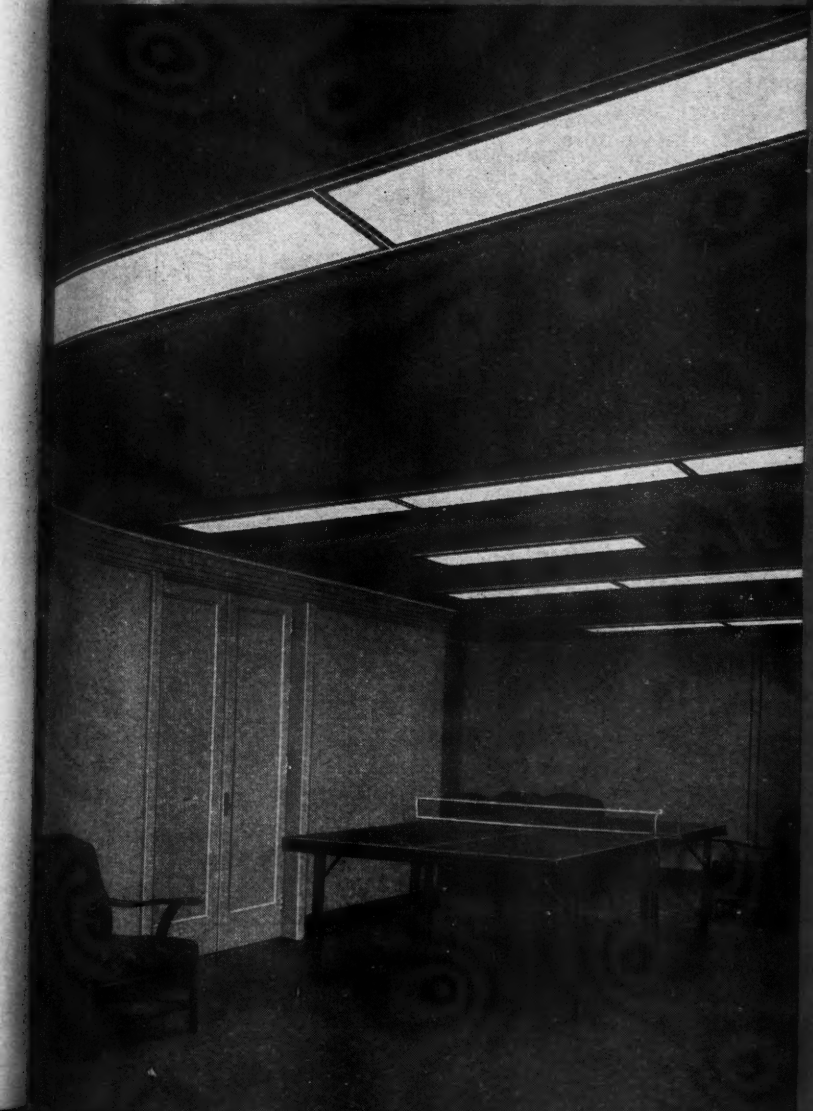


**ALL-STEEL-EQUIP COMPANY, INC.**
**600 Kensington Avenue, Aurora, Illinois**

**RACO • ALL-STEEL • PRODUCTS**
**SWITCH BOXES • OUTLET BOXES**

# Leader TROFFERLITES

*Give Better Lighting for Every Need!*



Yes, the standardized units in the Leader l
of Recessed Troffer fluorescent lighting fixtu
meet every troffer lighting need. They're id
for new construction — perfect for a remodel
job. They're adaptable to use as single units
in continuous runs.

Leader Trofferlites are available both open c
closed types; open, with or without louver
closed, with glass-panelled, piano-hing
frames. Installation methods for Trofferlites
simple and practical, and cover every type
ceiling construction.

Whatever your lighting problem, you'll so
it better with Leader Trofferlites. They're
tributed only by better electrical wholesal
You'll find the Leader representative in y
area helpful. Consult him *today*.

**LEADER ELECTRIC MANUFACTURING CO**
6127 NORTH BROADWAY • CHICAGO 40,
*West Coast Factory—2040 Livingston St., Oakland 6, C*

# WIREMOLD

## takes pleasure in *Announcing* the *Winners* of our Business Builders

# "HOW TO USE IT" *Competition*

*First* **PRIZE** *($500.00)*

**P. M. PAVESICH,**
**SUPER ELECTRIC CONSTRUCTION CO.,** **CHICAGO.**
Using WIREMOLD to wire fluorescent units in railroad office.

*Second* **PRIZE** *($250.00)*

**G. A. CHAMBLIN,**
**CALIFORNIA ELECTRICAL CONSTRUCTION CO.,** **SAN FRANCISCO.**
Using WIREMOLD to wire 8-story YMCA building.

*Third* **PRIZE** *($100.00)*

**G. C. SCHULTZ,**
**2931 MAPLESHADE ROAD,** **ARDMORE, PA.**
Using WIREMOLD No. 3000 and No. 700 in an office building from panel box to fluorescent units and outlets.

*Also:* **HONORABLE MENTION**

**FREDERICK LATZER,**
**Conduit Wiring Company, New York**
Using WIREMOLD No. 2100 for modernization of old fireproof building.

**E. J. BOUCHER,**
**O. B. McClintock Company, Inc., Minneapolis.**
Using WIREMOLD No. 2100 for test racks for clocks.

**ANDREW C. COLEGROVE,**
**Mystic, Connecticut.**
Showing various uses of WIREMOLD No. 3000.

## THE JUDGES

**S. J. O'Brien,** President, Electrical and Gas Association of New York, Inc., New York

**O. Fred Rost,** Editor and Publisher, Electrical Wholesaling, New York

**Victor H. Tousley,** Electrical Field Engineer, National Fire Protection Association, Chicago

**Laurence W. Davis,** General Manager, National Electrical Contractors Association, Washington, D. C.

## THE BASIS OF AWARDS

Decisions of the judges were based primarily on the idea of selecting those installations which prove that WIREMOLD is the logical material for solving certain types of wiring problems, and that demonstrate the wide adaptability and interconnectability of Wiremold in completing a wiring system "From Panel Box to Outlets."

## THE WIREMOLD COMPANY, HARTFORD 10, CONN.

# ..... DIRECT FACTORY COOPERATION THAT WORKS TO YOUR ADVANTAGE .....

## from AUSTIN Salesmen

• The Austin Wholesaler who sells *you* gets direct and complete cooperation that *ultimately* benefits you in utilizing and selling AUSTIN Products.

AUSTIN has 45 salesmen, strategically located throughout the country, doing intensive missionary work. This places the AUSTIN Wholesaler nearest you in an excellent position to serve you ably and dependably.

**BUY FROM YOUR WHOLESALER**

*We sell exclusively thru*
**WHOLESALERS**

**THE M. B. AUSTIN COMPANY**
108-116 S. DESPLAINES STREET
*Chicago 6, Ill.*

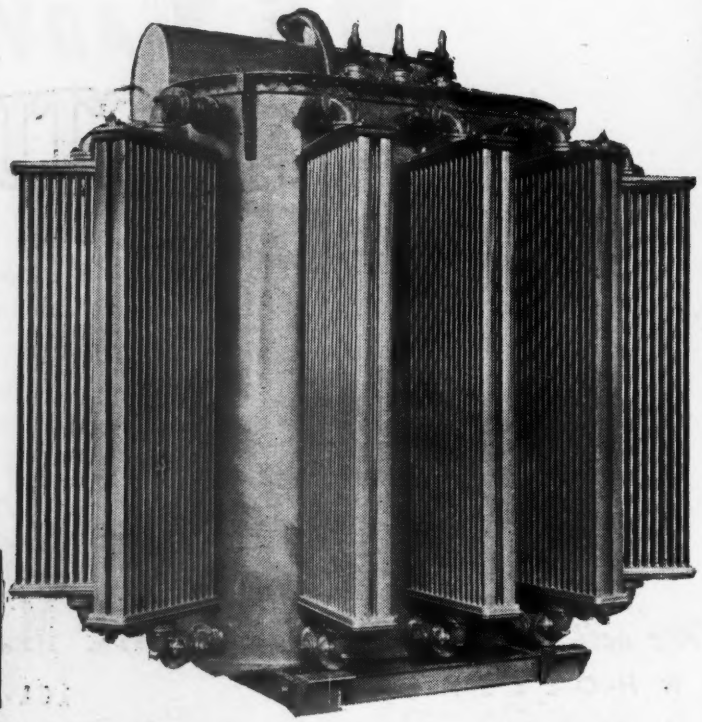
# Efficient Energy Transformation in all its forms — AMERTRAN

Power
Distribution
Rectifiers
Dry Types
Voltage Regulators
Industrial Electronics

● There is an accelerated trend, begun many years ago among top-flight engineers, to "take it up" with AmerTran. We have many case histories on file which prove the benefits of this talking it over with our engineers. In recommending a transformer for a more or less routine circuit function, it is possible very often to furnish a type which affects an improvement in operation, or a saving in space-weight considerations. Where tapped and multiple windings are involved in intricate circuits, this possibility becomes a virtual certainty.

In the established fields of utility and industrial power and distribution, AmerTran Transformers continue to anticipate and incorporate the latest design innovations—and to give that reliability of performance which has earned the confidence of the entire electrical industry.

We'll be very glad to consult with you on any phase of transformer practice.



**AMERICAN TRANSFORMER COMPANY**
178 EMMET STREET • NEWARK 5, N. J.

**AMERTRAN**
REG. U. S. PAT. OFF.
MANUFACTURING SINCE 1901 AT NEWARK, N. J.

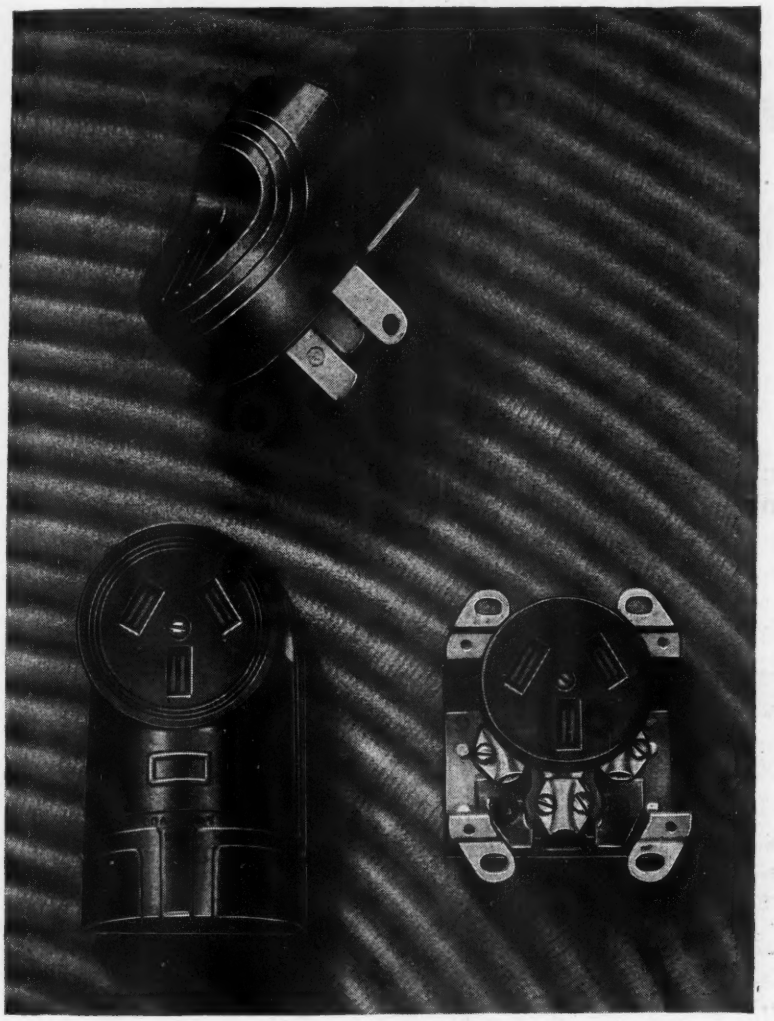
**Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission**

AMER TRAN

# RANGE OUTLETS

# H&H

## 3-Wire, 50 Amp., 250 V.



Upper figure: Range Cap No. 7952 of polished black Bakelite, designed to match the Receptacles. Lower left: Range Outlet No. 7950, surface type; polished black Bakelite. Also available in white Ivorylite: No. 7950-I. Lower right: Range Outlet No. 7987, flush type; polished black Bakelite. If wanted with .040" brush brass plate, specify No. 7990; with .060" plate, No. 7991.

## *with 90°-angle*

# RANGE CAP

These quickly-wired Outlets and Caps have every improved feature for easy installation *and use.* Straight-in wiring with solderless connectors make fast work of range hook-ups. *Surface* Range Outlet No. 7950 has built-in cable clamp interchangeable for back or bottom wiring. 2-screw contacts; 3/4" and 1" knockouts provided. *Flush* Range Outlet No. 7987 (with 2-screw contacts) is designed for 4" or 4 11/16" box and standard 3/4" plaster cover. Requires no special attachments. Grounding slots and contacts in the plate.

Both the surface and flush types take Range Cap No. 7952, for straight-in wiring and solderless connections. Built-in cable clamp eliminates awkward right-angle cable connections. Adapted for use with 3-wire all-rubber cable as well as metallic or non-metallic sheathed cable. Ground straps on Cap connect with ground clamp on Receptacle for easy and secure ground connections. Cap and Receptacle combination make a neat, compact installation with attractive harmony of design.

**DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS**

**HART & HEGEMAN DIVISION**

ADEQUATE WIRING SERVES AND SAVES

**THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.**

# HOMES THAT *STAY UP-TO-DATE*... START WITH

# G-E WIRING MATERIALS

In spite of housing shortages, your customers still look for *lasting* value when they buy homes. You can help them to achieve this value by providing electric systems that are suited to present and future needs.

You add life . . . you add value . . . you add *modernity* to homes when you use G-E wires and cables. There's another big benefit, too, because the name of General Electric means "quality" to the home buyer. It assures him of the good electrical service he wants. It makes him respect your judgment in the selection of products that will give him top value. And it brings him back when he is ready to buy again. Section W1-7-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

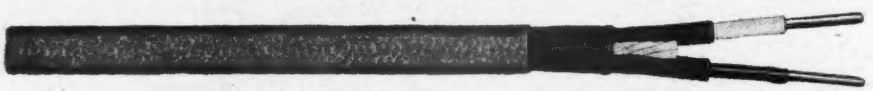
## G-E WIRES AND CABLES

**BX* ARMORED CABLE**

This armored cable is extremely flexible for easy handling. It resists moisture, and is flame-retarding for extra safety. An added feature is the S-shaped paper wrap which is easy to remove and gives greater protection. It also increases the dielectric strength of the cable. Available in all standard sizes, in 2, 3, and 4 conductors. Also in 2- and 3-conductor leaded cable, and bare armored ground wire.

**BRAIDX***

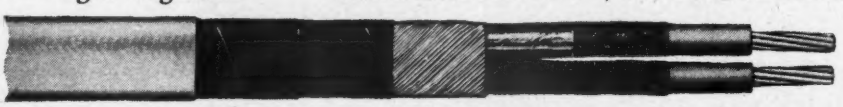
This non-metallic sheathed cable is recommended for old and new buildings, and for wiring additions and replacements. BraidX can be fished without supports from outlet to outlet, or can be run on dry surfaces of woodwork, plaster, cement, or brick. BraidX cable is resistant to moisture, flame, and mechanical injury. It is especially suitable for rural electrification. Available in sizes 14 to 4, in 2, 3, and 4 conductors, with or without ground wire.



**PVX***

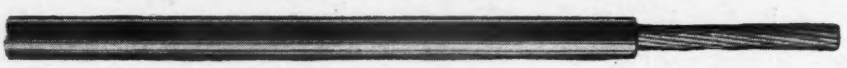
Thermoplastic insulation provides high dielectric and mechanical strength in this non-metallic sheathed cable. It is unusually resistant to oils, acids, alkalies, sunlight, and abrasion. PVX strips easily, and its light weight and positive conductor identification facilitate speedy installation. The Type T conductors are approved by Underwriters' Laboratories, Inc., for 60 C operation.

Available in sizes 14 to 4, with 2 or 3 conductors.



**SERVICE ENTRANCE CABLE**

This cable is used from the entrance cap to the meter equipment, and can be installed directly on the outside of buildings without conduit protection. Two-conductor round, and three-conductor oval service entrance or service drop cable is available in standard sizes, with or without galvanized flat steel armor.



**THERMOPLASTIC BUILDING WIRE (TYPES T AND TW)**

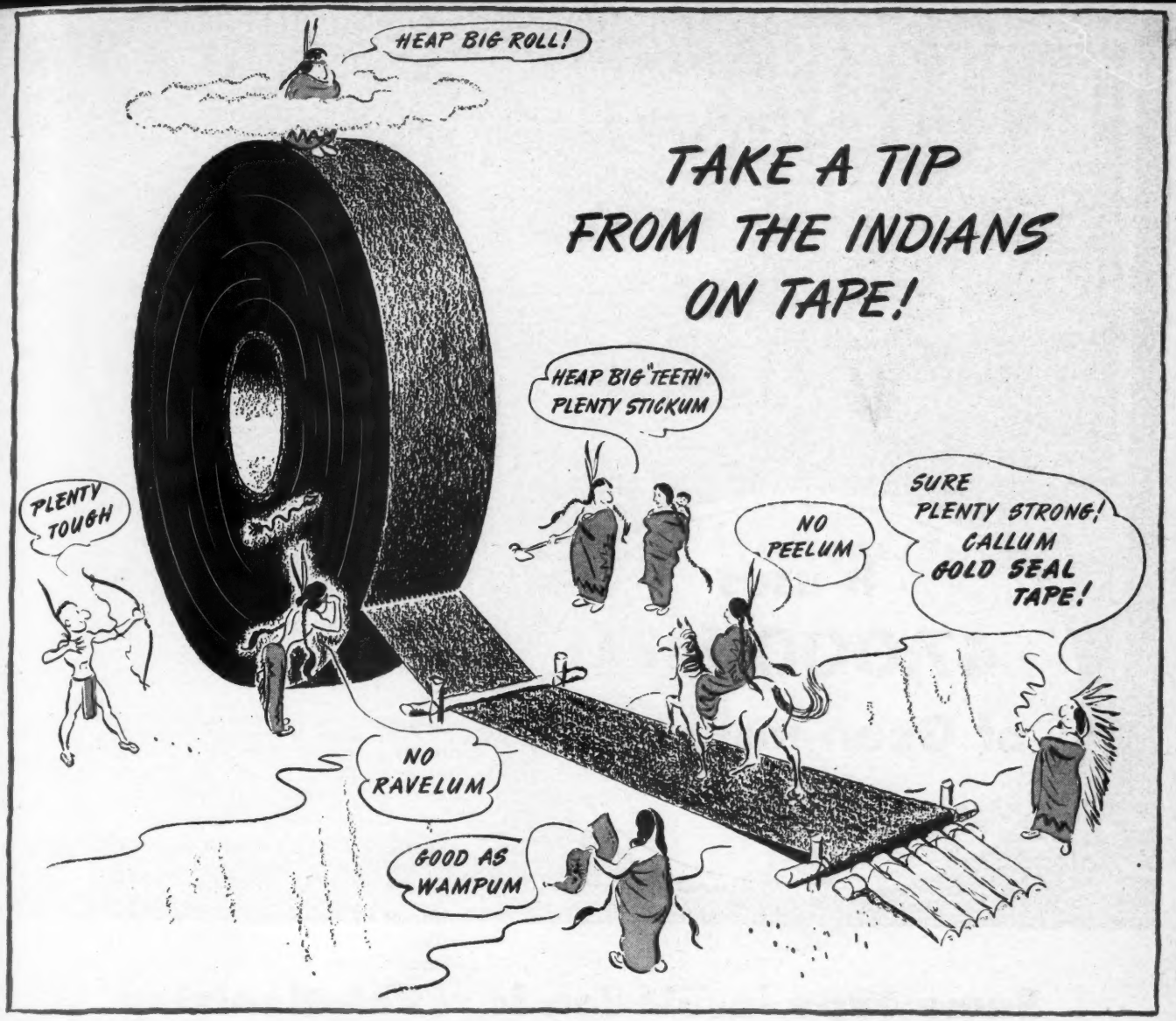
G-E thermoplastic building wire is a small diameter, thermoplastic-insulated wire made of highest quality materials, and produced to meet rigid specifications. It can be used for all wiring requirements where permitted by local codes, and is suited for varying conditions.

It resists flame, oils, acids, alkalies, and other chemicals and solvents, and is virtually unaffected by sunlight, moisture, and weathering.

All wire and cable listed here is approved by Underwriters' Laboratories, Inc.

**Trade-mark Reg. U.S. Pat. Off.*

# GENERAL ELECTRIC


HEAP BIG ROLL!
TAKE A TIP FROM THE INDIANS ON TAPE!
HEAP BIG "TEETH" PLENTY STICKUM
PLENTY TOUGH
NO PEELUM
SURE PLENTY STRONG! CALLUM GOLD SEAL TAPE!
NO RAVELUM
GOOD AS WAMPUM

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal specifications.

Even the Indians know the tape for the tough jobs! And while you may never see an application like this, wherever it's used, Gold Seal holds tighter – longer.

—Because there's plenty of lasting "tack" in the friction compound.

—Because every fibre of the base cloth is thoroughly impregnated.

—Because Gold Seal Tape is laboratory tested every step of the way.

—Because it's cellophane-wrapped and boxed to reach you factory-fresh!

Try a roll. You'll see the difference!

Jenkins Bros., Rubber Division, 80 White St., New York 13, New York.

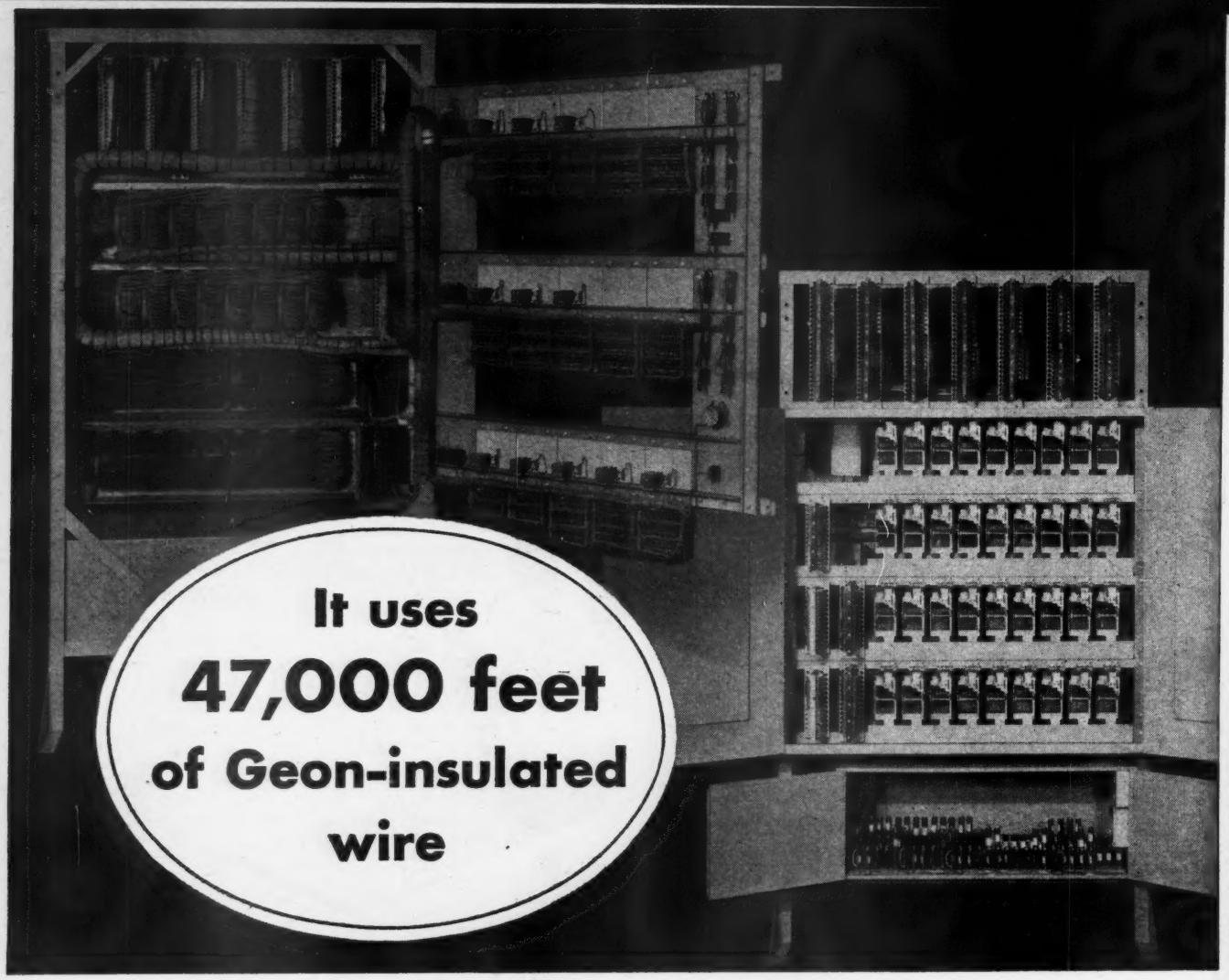
JENKINS

Jenkins Bros

# Gold Seal Tapes

FRICTION and RUBBER TAPES

MADE BY JENKINS BROS. . . . MAKERS OF FAMOUS JENKINS VALVES




# Same type insulation is revolutionizing home and industrial wiring

THESE front and rear views of a Rotary Switch and Relay Bank Rack—that's what Western Union calls it—give some idea of where all the wire goes. But they don't tell why so much Geon-insulated wire is used in machines like these as well as other equally complicated instruments designed and built by Western Union engineers.

Most important, of course, are the excellent electrical properties of insulation made from GEON. They permit a thinner coating of insulation. In instrument wiring that means that the assembly engineer has more room for doing his intricate job. In building wiring it means more conductors per conduit or smaller holes to be drilled.

But insulation made from GEON offers more than this. In all types of wiring it's easier to handle because it's smooth and non-sticky. It's easily identified because of the brilliant, permanent colors. It's highly abrasion resistant—pull it around sharp corners without fear of tearing. It resists water (GEON compounds, of course, are Underwriters approved for TW and other type wires); it resists oil and greases, acids and most other chemicals, sunlight and ozone, flexing, heat and cold, and most other normally destructive factors.

The next time you order wire—for manufacturing, home or industrial wiring—be sure to specify wire insulated with GEON now being made by leading wire and cable manufacturers. Or for more information please write Department Y-7, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

Geon
Polyvinyl Materials

**B. F. Goodrich Chemical Company**

A DIVISION OF THE B. F. GOODRICH COMPANY

# Who, Me?

**Sure, I use Central Rigid Steel Conduit—It's clean, easy to work with, and always of the same high quality.**

*"There's Tested Strength in Every Length"*

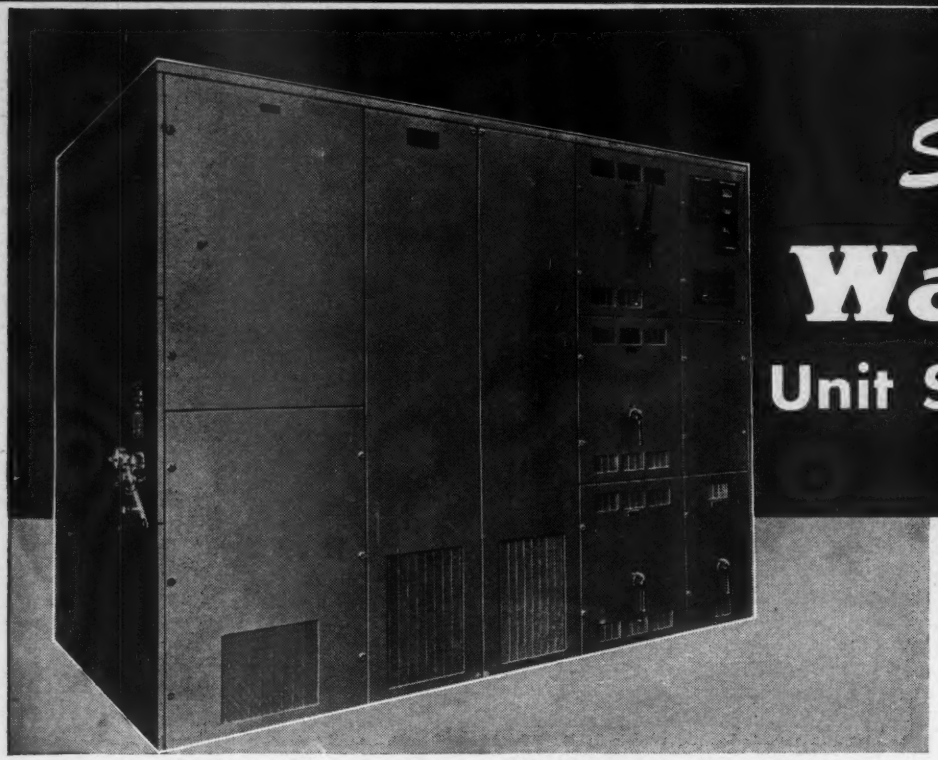
**CENTRAL**
**RIGID STEEL**
**CONDUIT**

**SPANG-CHALFANT**

Division of The National Supply Company

General Sales Office: Grant Building, Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities



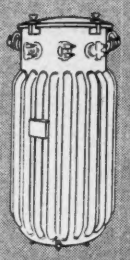
# *Specify* Wagner Unit Substations!

One order to Wagner brings everything needed to meet your exact transformer and switchgear needs—a complete unit substation engineered as a single unit, fully backed with undivided responsibility by Wagner.

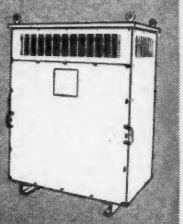
Wagner unit substations are easy to install—and when future load changes so dictate, easy to move intact to a new location.

In addition to (1) ease of ordering, (2) undivided responsibility, (3) simplicity of installation and (4) ease of relocation, Wagner unit substations offer you such other important advantages as (5) less installation expense, (6) maintenance is simplified, (7) low-voltage feeders are shortened, (8) less manpower needed to make changes, (9) built of the highest-quality materials in accordance with the latest engineering practices.

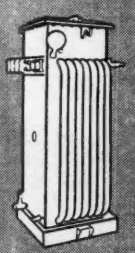
Get acquainted with entire Wagner line of distribution and power transformers. Ask for Bulletins TU-180 and TU-181, gladly sent on request addressed to Wagner Electric Corporation, 6413 Plymouth Avenue, St. Louis 14, Mo.



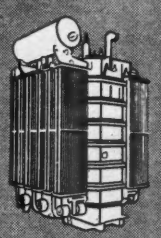
Distribution Transformers



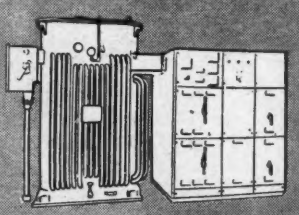
Air-Cooled Transformers



Nofiamel Transformers



Power Transformers



Unit Substations

*Other Wagner Products for Industry:* Air Brakes • Brake Lining • Electric Motors • Hydraulic Brakes • Industrial Braking Systems • NoRoL • Tachograph

***Consult Wagner Engineers on all Transformer Problems***

**Wagner**

T46-3

*Sales and Service Branches:* ATLANTA 3 • BALTIMORE 18 • BOSTON 15 • BUFFALO 8 • CHICAGO 16 CINCINNATI 10 • CLEVELAND 15 • DALLAS 1 • DENVER 2 • DETROIT 2 • HOUSTON 2 • INDIANAPOLIS 4 KANSAS CITY 8 • LOS ANGELES 15 • MEMPHIS 3 • MILWAUKEE 2 • MINNEAPOLIS 4 • NEW YORK 7 OMAHA 2 • PHILADELPHIA 8 • PITTSBURGH 13 • PORTLAND 9 • ST. LOUIS 3 • SALT LAKE CITY 1 SAN FRANCISCO 3 • SEATTLE 4 • SYRACUSE 2 • TULSA 3 • WASHINGTON 5
*In Canada:* WAGNER ELECTRIC AT LEASIDE, ONTARIO

**"HAUL AWAY,"** calls Gus, and from the next floor Elmer pulls four wires through the old conduit. They're modernizing a building the practical, economical way — doubling the number of circuits by installing wires with thin-walled, high-dielectric insulation of VINYLITE plastic.

But small-diameter compactness is only one of the outstanding advantages of VINYLITE plastic insulation for wires and cables. Highly resistant to moisture, oils, abrasion and most chemicals, it stays flexible at extremely low temperatures and has an extremely low rate of water absorption. Some types are non-flammable; others slow-burning. All are virtually non-aging. They're available in a wide color range for ready circuit identification—opaque, transparent, and crystal clear.

VINYLITE plastic insulation is bringing new safety and service life to makers of electric and electronic equipment, public utilities, construction firms, and automotive, marine, and airplane manufacturers. Adopt it now for your own requirements. Write Department 41-W for booklet W-4, "VINYLITE Plastics for Wire and Cable Insulation." It describes the various types now in use in widely diversified applications, and serving dependably year after year under conditions frequently destructive to other insulating materials.

# VINYLITE

TRADE-MARK

## PLASTICS

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 EAST 42ND STREET, NEW YORK 17, NEW YORK



MAXIMUM OPERATING TEMPERATURE

*A point to remember....*

You get more profits in today's small-homes market when you include telephone raceways in your electrical contracts.

Concealed wiring and handy wall-plate outlets are a real convenience to the home-buyer. By selling more architects and builders on this idea, you increase the total number of outlets per job.

. . .

REMEMBER—*No electrical contract is really complete unless it includes raceways for built-in telephone facilities.*

**BELL TELEPHONE SYSTEM**

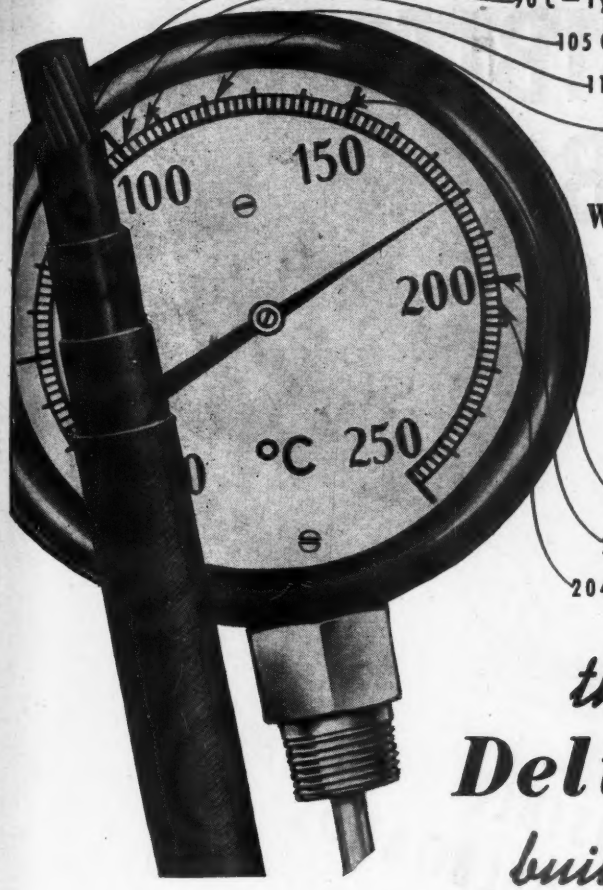
**MAXIMUM OPERATING TEMPERATURE**

90 C — Type AVB Power Cable (600 volts)

105 C — Limit for Class A (organic) insulating materials — AIEE

110 C — Type AVA Power Cable (600 volts)

125 C — Type AI Power Cable (600 volts)




# where TEMPERATURES are on the HIGH SIDE..

150 C — Recommended limit, Cu Conductors

200 C — AA Asbestos-ASB braid (300 volts)

204 C — GV Glass-Silicone Impregnated

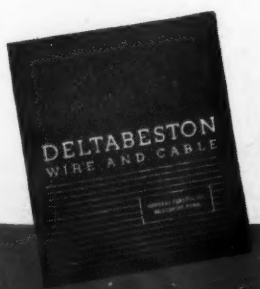
## *there's a Deltabeston* Cable built to beat the heat*

Wherever wiring must withstand high temperature, you'll find that it pays to check the complete Deltabeston line of heat-resisting wires and cables.

There's a Deltabeston cable to meet the conditions normally encountered around furnaces, soaking pits, and hot strip mills. Other types are built specifically for boiler-room applications, and for jobs that must combine heat resistance with moisture resistance.

From the Deltabeston catalog, you can choose wire or cable for use in or out of conduit, with the degree of flexibility that the installation requires. If your conditions are highly unusual, specialists in the field of heat-resisting cable are "on call" to find the best solution to your problem.

**Trade-mark Reg. U.S. Pat. Off.*




**For your copy of the Deltabeston catalog, showing the full line of types available for each temperature and voltage range, write Section Y-2-78, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn. All Deltabeston Wires and Cables are distributed nationally by G-E Merchandise Distributors.**

GENERAL ELECTRIC

FOR BETTER FUSIBLE PANELBOARD JOBS...
YOURS FOR THE ASKING!
WURDACK
FUSIBLE PANELBOARDS
WM. WURDACK ELECTRIC MFG. CO.
Send for your copy!

# More answers to your questions about

# *Certified Ballasts*

**BUY CERTIFIED BALLASTS, because . . .**

1. Certified Ballasts are built to exacting specifications.
2. They're tested, checked and *Certified* as meeting those specifications by famous Electrical Testing Laboratories, Inc.
3. Leading fluorescent tube makers will guarantee lamp performance when Certified Ballasts are specified in fixture.
4. You get good lamp performance, good fixture operation and minimum service worries, when you use Certified Ballasts.

## Why *Certified* Ballasts are better

**Q.** ***How does a Certified Ballast assure good lamp performance?***

**A.** In all technical characteristics, Certified Ballasts are built to perform a balanced operation with the lamps for which they are designed. All of the features listed below have a definite influence on good lamp performance.

**Q.** ***What about noise?***

**A.** Certified Ballasts are quiet in operation. Ballast hum is also dependent on proper installation . . . such as in Certified Fleur-O-Lier and RLM fixtures.

**Q.** ***What about long life?***

**A.** Certified Ballasts, properly installed, will normally outlast the entire lighting installation itself.

**Q.** ***What about heating?***

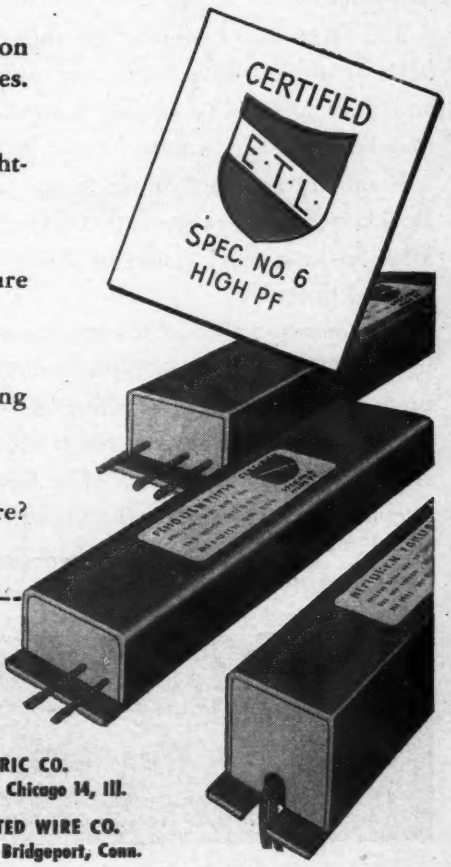
**A.** Certified Ballast specifications guard against any dangerous temperature rise which might affect operation.

**Q.** ***What about uniform quality?***

**A.** Latest manufacturing methods, plus rigid testing by Electrical Testing Laboratories, Inc., assure and guard uniform high quality.

**Q.** ***What about cost?***

**A.** Certified Ballasts *cost no more* than any other ballasts. So why not be sure? Look for the ETL Certification mark on the equipment you specify.




## Certified Ballast Manufacturers

*Makers of Certified Ballasts for Fluorescent Lighting Fixtures*

**THE ACME ELECTRIC & MFG. CO.**
Cuba, New York

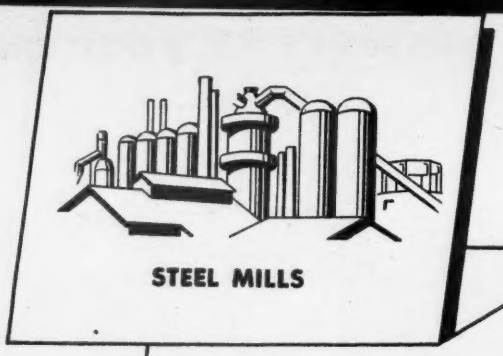
**CHICAGO TRANSFORMER DIVISION**
Essex Wire Corporation
3501 Addison St., Chicago, Illinois

**GENERAL ELECTRIC CO.**
Speciality Transformer Division
Fort Wayne, Ind.

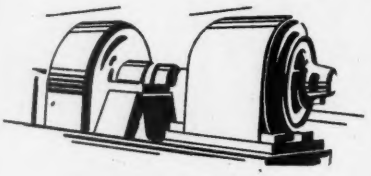
**JEFFERSON ELECTRIC CO.**
Bellwood, Illinois

**SOLA ELECTRIC CO.**
2525 Clybourn Ave., Chicago 14, Ill.

**WHEELER INSULATED WIRE CO.**
378 Washington Ave., Bridgeport, Conn.

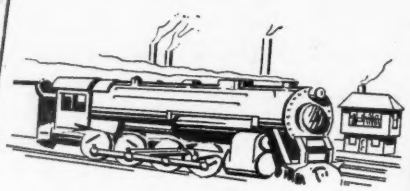


STEEL MILLS

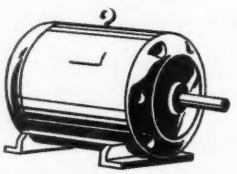


POWER PLANTS

INDUSTRIAL PLANTS



RAILROADS



ELECTRICAL EQUIPMENT

# ROCKBESTOS A.V.C.
# Guards Circuits Against Failure and Reduces Electrical Maintenance in Factories, Mills and Utilities

The reason you find so much Rockbestos A.V.C. in circuits exposed to severe operating conditions is that these permanently insulated wires, cables and cords guarantee dependable operation by eliminating wire-failures.

The *impregnated asbestos insulation* . . . an armor that withstands heat, aging, corrosive fumes and moisture . . . insures power, control and lighting circuits against failure in high ambient temperatures, under overloads, or exposure to oil, grease and other destructive agents.

Eliminate repeated re-wiring and expensive maintenance by using Rockbestos wires, cables and cords in circuits around boilers, furnaces, kilns, soaking pits . . . and in steam tunnels, pump rooms and heat-exposed ducts.

*Permanently insulated* Rockbestos wires, cables and cords are made in 125 different standard types in 300 to 5000 volt ratings and in sizes up to 2,000,000 CM. Everything from magnet wire to multi-conductor power cables . . . National Electrical Code types . . . and Rockbestos All-Asbestos constructions. For information on the advantages of *permanently insulated* Rockbestos write for a catalog.

**ROCKBESTOS PRODUCTS CORPORATION**
**204 Nicoll St., New Haven 4, Conn.**

The Rockbestos A.V.C. Power Cable illustrated (Type AVA) with an impregnated asbestos and varnished cambric insulation, protected by a heavy asbestos braid, is only one of 125 wires, cables and cords developed for severe operating conditions by Rockbestos. All are designed to resist the destructive effects of heat and moisture, corrosive fumes, grease, oil and flame.

ROCKBESTOS
PERMANENTLY INSULATED WIRES AND CABLES

**ROCKBESTOS A.V.C.**
***The Wire with Permanent Insulation***

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS
LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

# IT SETS HEAT BACK ON ITS HEELS

Cutler-Hammer engineers have gone far ahead in meeting the problem of internal heating in safety switches. Not only have they designed a new safety switch mechanism which will carry *its* rated load with only nominal heating, but they have gone even further. They have designed the entire safety switch to withstand safely any degree of heat that can be expected from correctly selected fuses. In fact, the all-important jaw springs for example are made of non-ferrous alloy providing new, unique *heat-protection* here, too.

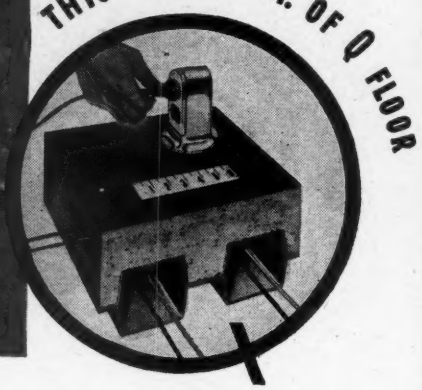
Also these outstanding safety switches are engineered to the last detail for easier installation, better appearance, convenience and safety. *More* reasons why this new line is featured by Cutler-Hammer wholesalers and leading contractors from coast to coast. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin.

**IT'S THE NEW**

CUTLER-HAMMER
SAFETY SWITCHES
C-H

# CONTINUOUS ELECTRICAL CHANGE

## is good building economy




The main selling point for Q-Floor is that it encourages tenants to stay up to date electrically. It is steel, and so constructed that an outlet can be established on any six-inch area of the entire exposed floor.

Q-Floor is sold on the theme that buildings avoid obsolescence if they are constructed to adapt their floor layouts to new electrical needs. It has been approved by Underwriters' Laboratories, Inc., in accordance with article 356 of the National Electrical Code and is adaptable to any type of wiring.

Continuous change keeps the electrician continuously busy, but in the over-all economy of owning a building, up-to-dateness is much less expensive than out-of-dateness.

**H. H. ROBERTSON COMPANY**

2400 Farmers Bank Building
Pittsburgh 22,
Pennsylvania

Offices in 50 Principal Cities World-wide Building Service

**Electrical fittings for use with Robertson Q-Floors can be obtained from General Electric Construction Materials distributors. See the nearest G.E. merchandise distributor for information on how Q-Floor fittings can be used to attain up-to-the-minute electrical wiring.**

## Q-FLOORS AND ELECTRICIANS ARE PARTNERS

in the business of keeping buildings young

# CROUSE-HINDS

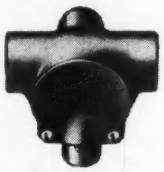
# Flexible Fixture Hangers

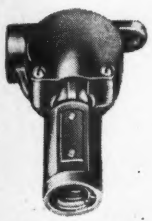
## easy to install — long life — low maintenance cost

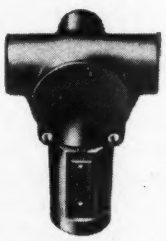
The illustrations show a representative selection from the dozens of types and sizes of flexible lighting fixture hangers that are listed in Crouse-Hinds Condulet Catalog 2500.

**No. 11**
of a series of advertisements which demonstrate, that CROUSE-HINDS "complete line" means much more than just a range of sizes—there is a wide variety of highly specialized types in each classification.

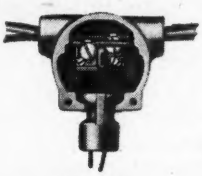
Type ALA Ball Hanger

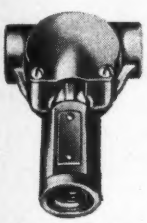

Type ALT Ball

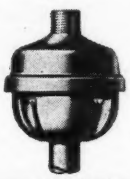

Type ALA Cushion Hanger


Type ALT Cushion

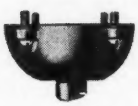
Type ALC Ball
Broken-away view

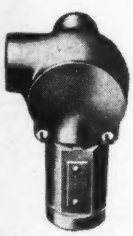

Type ALC
with Connection Block
Cover Removed


Type ALC Cushion


Type AHG Cushion
Vaportight

Type ALL Ball


Type GS Ball

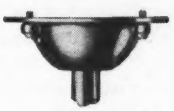

Type ALL Cushion

Type GS Cushion

Type H Cushion

Type UNJ Ball

Type UNJ Ball


Type ARB Ball

Type ARB Cushion

Type OFH Cushion

Type OFH Cushion with
Clamp for Span Wire

Type UNJC Cushion

Type UNJC Cushion

Type UNC Cushion

Type COUP Locking
Coupling for locking
fixture stem to
Condulet hub

Type OSA

Type UNH Hook
Male

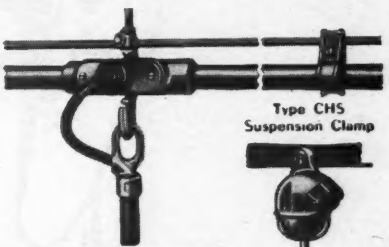
Type UNH Hook
Female

Type UNHC Cushion

Type UNE Loop
Male

Type UNE Loop
Female

Type FOH
for fluorescent
lighting fixtures


Type C Condulet Suspended
on a Span Wire with
Type OSA Suspension Hanger

Type C Condulet with
Fixture Hook and Loop

Type CHS Suspension
Clamp with Ring

Type ALC Ball
Fixture Hanger with
Lighting Fixture

Type CHS
Suspension Clamp

Type OFH Cushion
Fixture Hanger
Bolted to Structure
with Lighting Fixture


Type GS Ball
Fixture Hanger with
Type GSC Condulet
and Lighting Fixture

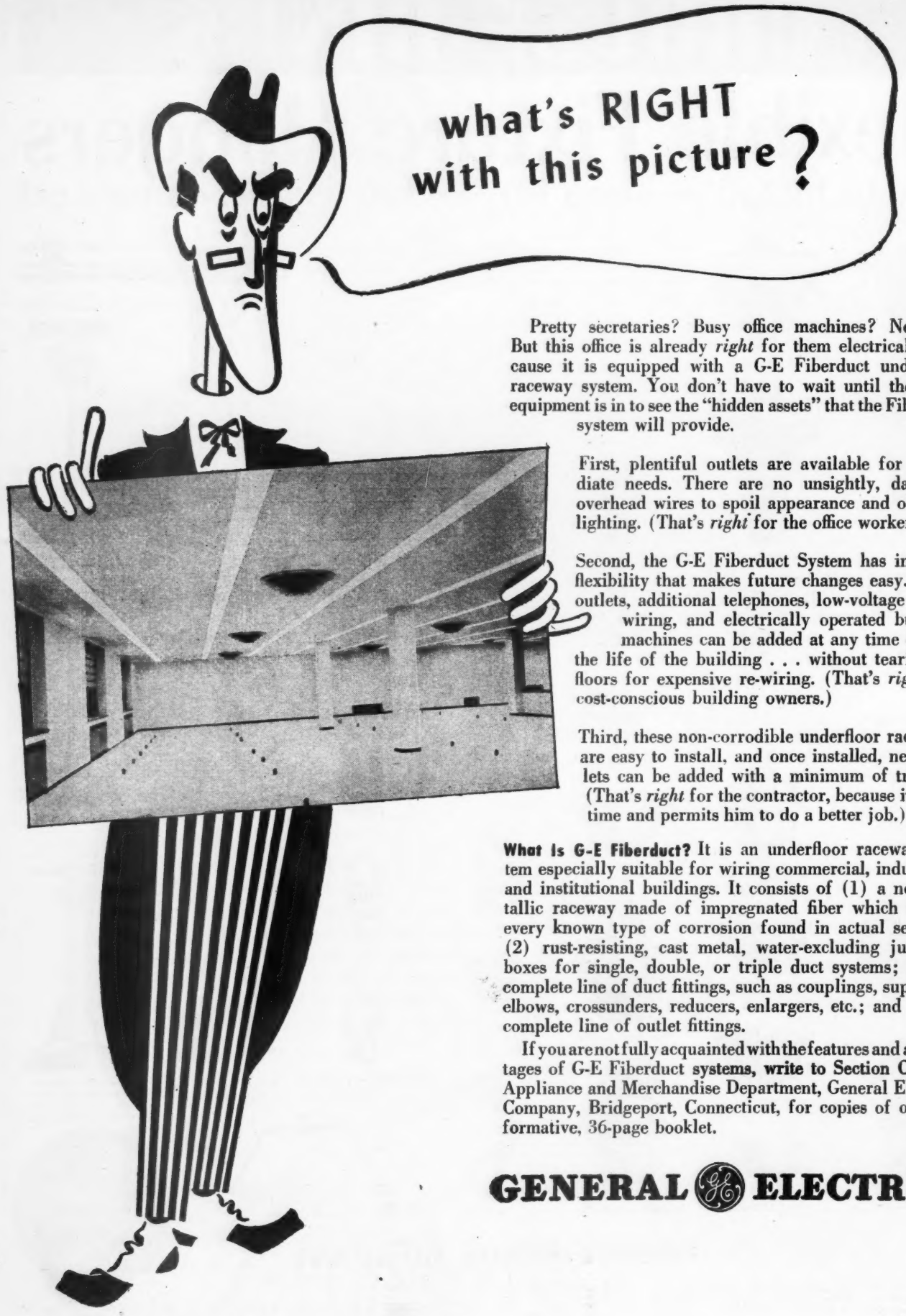
Type AHG Cushion
Fixture Hanger with
Type T Condulet and
Type VDA Lighting Fixture

A Nationwide Distribution Through Electrical Wholesalers

**CROUSE-HINDS COMPANY**
**Syracuse 1, N. Y., U.S.A.**

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington *Resident Sales Engineers:* Albany — Atlanta — Charlotte — Indianapolis — New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD. *Main Office and Plant:* TORONTO, ONT.

**CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS**




Pretty secretaries? Busy office machines? Not yet! But this office is already *right* for them electrically, because it is equipped with a G-E Fiberduct underfloor raceway system. You don't have to wait until the office equipment is in to see the "hidden assets" that the Fiberduct system will provide.

First, plentiful outlets are available for immediate needs. There are no unsightly, dangling overhead wires to spoil appearance and obstruct lighting. (That's *right* for the office workers.)

Second, the G-E Fiberduct System has inherent flexibility that makes future changes easy. Extra outlets, additional telephones, low-voltage signal wiring, and electrically operated business machines can be added at any time during the life of the building . . . without tearing up floors for expensive re-wiring. (That's *right* for cost-conscious building owners.)

Third, these non-corrodible underfloor raceways are easy to install, and once installed, new outlets can be added with a minimum of trouble. (That's *right* for the contractor, because it saves time and permits him to do a better job.)

**What Is G-E Fiberduct?** It is an underfloor raceway system especially suitable for wiring commercial, industrial, and institutional buildings. It consists of (1) a non-metallic raceway made of impregnated fiber which resists every known type of corrosion found in actual service; (2) rust-resisting, cast metal, water-excluding junction boxes for single, double, or triple duct systems; (3) a complete line of duct fittings, such as couplings, supports, elbows, crossunders, reducers, enlargers, etc.; and (4) a complete line of outlet fittings.

If you are not fully acquainted with the features and advantages of G-E Fiberduct systems, **write to Section C3-7-8**, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut, for copies of our informative, 36-page booklet.

**GENERAL ELECTRIC**

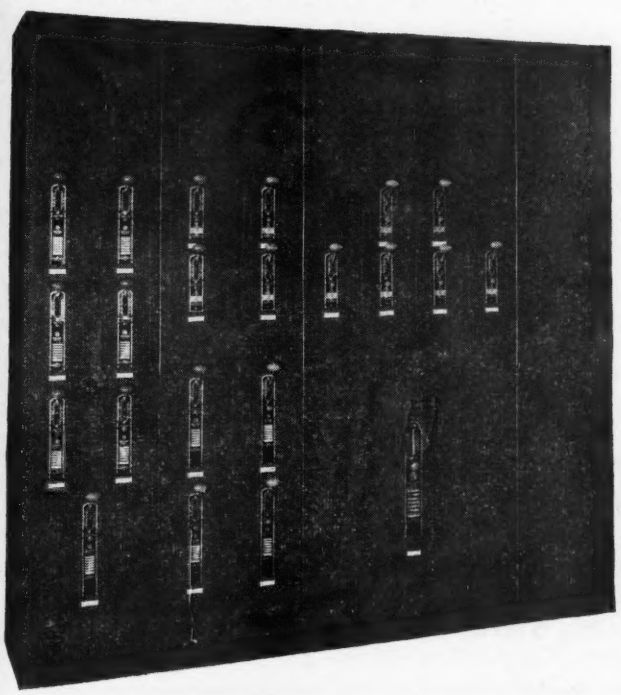
# SHUTLBRAK SWITCHBOARDS

## Make it Easy to PLAN FOR THE FUTURE

**(FA) DESIGNED for FLEXIBILITY . . .** (FA) one-piece switchboard units can be conveniently arranged — singly or grouped. Removable end walls permit adding sections to either side.

**(FA) SECTIONALIZED for EASE and ECONOMY of INSTALLATION . . .** (FA) assembled and shipped ready for connection of main and branch circuit cables . . . reducing installation costs. Sections readily fit together . . . with built-in junction boxes at top plus removable covers.

**(FA) TAILORED TO MEET YOUR EXACTING REQUIREMENTS . . .** Number and capacity of (FA) Shutlbrak Switches provided *as specified by you.*



Switchboards like everything else must keep pace. They should be planned with an eye to the future. (FA) Shutlbrak Switchboards make it easy not only to provide adequately for present day needs, but for future expansion as well.

Each unit of these modern, safety-type, heavy duty switchboards is self-contained, with all switch units connected to the bus bars of that section. Each has a junction box built into the top of the panel so that any number of units can easily and quickly be joined side by side or otherwise arranged to fit available space.

The (FA) Shutlbrak Switch, the outstanding characteristic of this switchboard, embodies the latest design and construction for a high quality heavy duty industrial switch with quick make and break connections held under compression by a tempered steel spring in the shuttle enclosure and with (FA) Kamklamp fuseholders. All copper surfaces are silver plated for good and lasting service. All steel parts are either made of galvanized steel, or cadmium plated. Switches are of interlocking type.

If it is high quality heavy duty switching that you need, insist on (FA) Shutlbrak Switchboards — the switchboard for today and tomorrow!

EST. 1891 — THE SIGN OF A BETTER JOB

Frank Adam

SHUTLBRAK

FRANK ADAM ELECTRIC CO.
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# MASTER ELECTRICAL SPECIFICATIONS

## with REVIEW of the 1946 NATIONAL ELECTRICAL CODE

## *in September Issue*

**4.1 Service Switches**
- 4.11 Oil Circuit Breakers
- 4.12 Air Circuit Breakers
- 4.13 Enclosed Knife Switches
- 4.14 Fuses and Protective Devices

**7.1 Signal and Communication**
- 7.11 Wiring Diagram and Layout
- 7.12 Apparatus and Equipment
  - 7.121 — Bells and Buzzers
  - 7.122 — Interphones
  - 7.123 — Sound Systems
  - 7.124 — Fire Alarm
  - 7.125 — Time, Watchman's Clock, Program
  - 7.126 — Radio
  - 7.127 — System by Others
- 7.13 Wiring

**This issue will contain these important sections:**
- 0.1 Index
- 0.2 Introduction
- 1.1 General Conditions
- 0.3 Procedure
- 2.1 Service Entrances
- 2.2 Grounding
- 3.1 Substations and Vaults
- 4.1 Service Switches
- 4.2 Panels and Cabinets
- 5.1 Feeders
- 5.2 Bus Bar Distribution Systems
- 5.3 Underground Distribution Systems
- 6.1 Branch Circuits
- 6.2 Special Raceway Systems
- 6.5 Emergency and Auxiliary Wiring Systems
- 7.1 Signal and Communication
- 8.1 Lighting Components and Fixtures
- 8.2 Apparatus and Equipment
- 9.1 Data Tables
- 10.1 Appendix

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● Published every third year starting with 1936. Acclaimed each time by architects, consulting engineers and electrical contractors alike as the greatest publishing service rendered to them by any electrical magazine.

● Each section will be written as specification paragraphs enabling you to prepare your own specifications by copying directly from this master reference.

● Each specification paragraph will be coded numerically for easy reference, and whenever there is a corresponding A. I. A. code number, it will be listed along with the Master Electrical Specification number. Since you, as electrical specialists, need more specific material for writing electrical specifications, our code numbering system will necessarily be much more detailed than the A. I. A. code.

● Included in this same issue—along with the regular editorial departments—a 12-page appendix pointing out, discussing and interpreting the 1946 Revision of the National Electrical Code.

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**Do you have an architect or consulting engineer to whom you would like a copy of this special issue sent? If so, send us his name and address, and we will see that he receives a copy without any obligation to you.**

# Electrical Contracting

*The Magazine of Electrical Construction and Maintenance*

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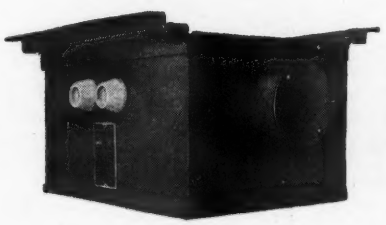
# what do you know about *Cold Cathode* lighting...

**Cold Cathode lighting is the modern, advanced form of fluorescent lighting. It overcomes the barrier of old fashioned lighting fixtures to which modern architectural design has had to limit itself. Now a modern building can have modern lighting, that in addition to being decorative also provides light output and color harmony to exactly meet the purpose of the room.**

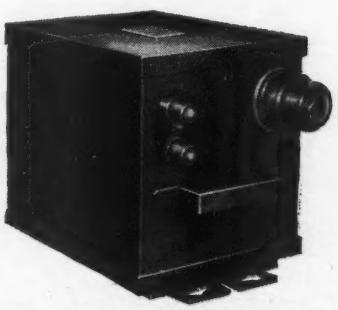
**The first Cold Cathode tubes were custom made, but as the advantages of this form of lighting became apparent, standard size tubes were developed. This development naturally simplified and economized installations.**

**Properly processed Cold Cathode tubes will operate indefinitely without service or maintenance. Most tubes are sold under a 10,000 hour guarantee—but many installations have recorded 20,000 to 30,000 hours of service. Added to the advantage of long life is the fact that Cold Cathode lighting provides a more effective light output at a lower cost, as much as 30 to 40 lumens per watt.**

**Acme Electric engineers have assisted in many ways to help make Cold Cathode lighting practical and economical. Contributing to this performance are the series of Acme transformers and Acme ballasts that are preferred by leading lighting engineers. For further information about Cold Cathode lighting and Acme Electric transformers and ballasts, write for bulletins 162 and 165.**



Heavy duty, industrial type Cold Cathode lighting transformer. Available in 120 MA, 6000, 7500, 9,000, 12000 volt secondaries.



Heavy duty, commercial type Cold Cathode lighting transformer. Available in 120 MA, 5000 to 12000 volt secandaries.

Cold Cathode lighting ballast, for powering 2-20 MM or 2-25 MM 93" long standard tubes.

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Acme Electric also manufactures Luminous Tube Transformers — Fluorescent Lamp Ballasts — Cold Cathode Lighting Transformers and Ballasts — Mercury Vapor Lighting Transformers — Radio and Television Transformers — Electronic Transformers — Door Bell, Chime and Signalling Transformers — Safety Transformers — Voltage Regulating Transformers—Step Down Transformers—Control Transformers—Warp-Stop Transformers—Capacitor Transformers for Power Factor Correction.

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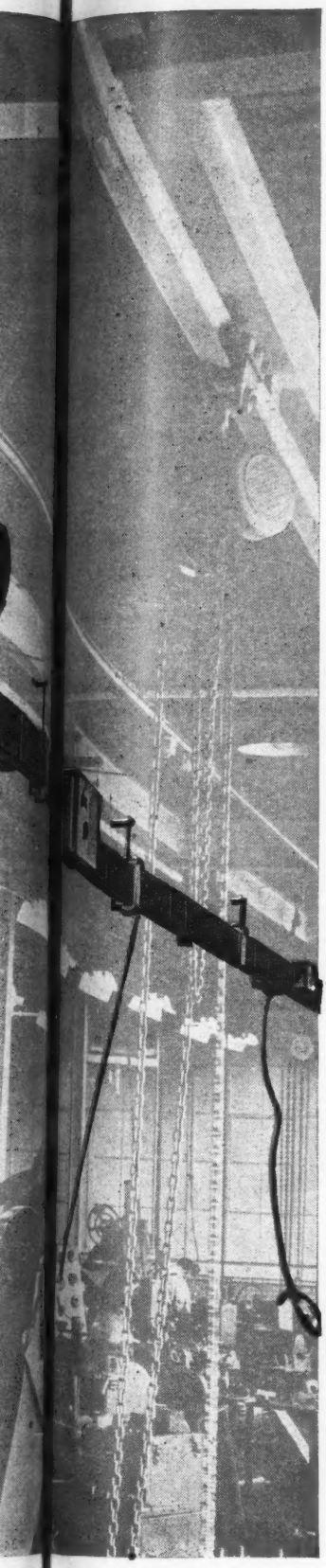
1434 St. Catherine St., W., Montreal 25, Que.

# Plugged in . . . powe

**NO WAITING FOR POWER** *with a BUStribution System—simply raise the plug to the nearest plug-in opening, snap its contact fingers over the busbar conductors and bolt the plug to the duct casing. The plug itself is a current protective device for the machine it serves.*

# on . . . time 12 minutes



## you can do it with BullDog BUStribution DUCT

Quick production changes are easy to make in a plant equipped with BullDog BUStribution Duct, because each 10-foot section has ten handy plug-in outlets for the ready insertion of circuit-protective plugs to convey current from the bus bars in the duct to the machine.

**One machine or a whole battery of machines can be moved—anywhere in your plant—without costly delays for rewiring. It's actually less than a 12-minute job to plug in a machine at any new location—and you cut in the power without down time for the rest of the line.**

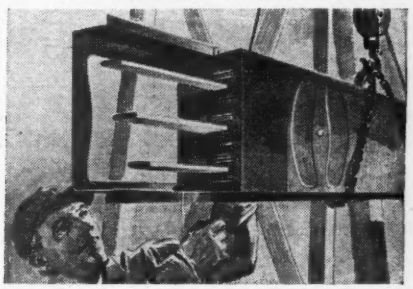
Because they are prefabricated, BullDog Bus Duct systems save countless hours of installation time. And their flexibility gives you power and light where they are needed and when they are needed. BullDog Duct systems can be moved quickly from one production set-up to another with complete re-use of all material and full protection against accidental short circuits.

**If you would like to learn more about this flexible, economical method of power distribution, call a BullDog field engineer, or write for descriptive folders.**

• • •

BullDog Also Manufactures Vacu-Break Safety Switches — SafToFuse Panelboards — Switchboards—Circuit Master Breakers—Industrial Trol-E-DUCT for Portable Tools, Cranes and Hoists—Universal Trol-E-DUCT for completely flexible lighting.

**SCREW DRIVER AND WRENCH** *are all the tools you need to completely dismantle and reassemble a BullDog BUStribution System. Made up of prefabricated, standardized sections, the entire system can be used again and again in new combinations and at new locations. No fabrication on the job is necessary.*



**NO SCRAP WITH ANY MOVE!** *There is no waste when you move a BullDog BUStribution System from one location to another. The component materials—steel duct, copper bus bars and vitreous porcelain—do not readily deteriorate and can be used indefinitely.*

*Capacities: Feeder Type—600 Amps. to 4000 Amps.; Plug-in Type — 225 Amps. to 1350 Amps.*

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## ELECTRICAL DISTRIBUTION SYSTEMS

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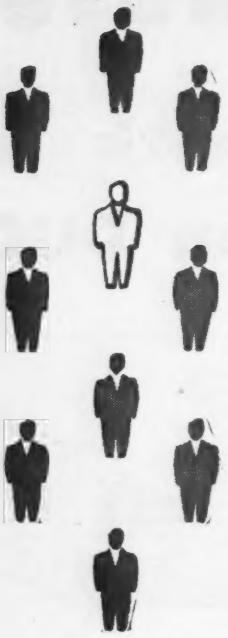
**In Canada: BullDog Electric Products, Ltd., Toronto. Field Engineering Offices in All Principal Cities.**



# 9 OUT OF 10 *want* THE PAYROLL SAVINGS PLAN CONTINUED!

Thanks to the cooperation and encouragement of America's industrial executives, 85 million bond holders have bought U.S. Bonds in the greatest savings program in history. Employees who have purchased billions of dollars of these bonds during the war now want to continue monthly purchases of savings bonds. Specific evidence of this desire to continue saving for personal security and prosperity through the Payroll Savings Plan was recently revealed by a survey which disclosed that 90% wanted the Plan continued.

Every employer can write in his own set of reasons why the Payroll Savings Plan should be continued as a part of his personnel relations program, but the principal advantages are obvious:

*A large reservoir of national savings; a strong and stable bulwark against inflation.*

*An "automatic" thrift habit for the worker; to increase contentment and satisfaction in his job.*

*An opportunity for the employee to maintain his "share in America" with the safest, easiest, most profitable investment he can make.*

*An opportunity for the returned veteran to share in the Payroll Plan's varied benefits.*

**Your employees will require little "selling" on the idea—they are accustomed to their monthly saving habit. With the Treasury Department's savings bond program now in peacetime operation, your partnership is again invited to continue this systematic, convenient means of contribution to a prosperous peacetime future.**

*The Treasury Department acknowledges with appreciation the publication of this message by*

## ELECTRICAL CONTRACTING

*This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and Advertising Council*

# IMPORTANT—

## ..in assuring job dependability!

# ACCURATE TAPES

THESE quality tapes — rubber and friction—have *all* the qualities required to reduce job costs and improve job quality. And because they offer the user these important advantages on the job, these quality tapes have acquired a level of trade acceptance which automatically generates faster, more consistent sales in volume . . . sales based on a twenty-five year reputation for dependable uniformity in sticking quality, mechanical and dielectric strength as well as full footage per roll.

While ACCURATE tapes are manufactured to the most exacting standards, under rigid quality control, and from the finest materials procurable, these tapes cost no more than other tapes. Actually they cost less because their better working qualities save time in all phases of installation and repair . . . hence lower job costs. Write for details.

*..IMPORTANT, too in advantages that mean a better, faster job!*

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OVER A QUARTER CENTURY OF TAPE SPECIALIZATION

# OPA IS DYING—
# . . . *what next?*

IT IS NOW clear that direct price control of the OPA type is on the way out, if not by legislative limitation then by administrative collapse.

It is equally clear that we are by no means past the danger of a swirling upsurge of prices.

Then does it follow that the passing of OPA need be tantamount to a decision to let 'em rip?

It does not.

While the OPA machinery is grinding to a stop, we can bring into play more fundamental measures to keep prices within safe limits—and to allow private management a wider area of freedom. What this article proposes is a framework of control within which private business judgment can operate. Therefore, this preamble speaks directly to our friends in the business community.

Now is a time for unrelenting self-restraint by business management. As price control disintegrates, business must scrupulously hold to prices which, after covering costs, yield *normal* profit margins. Business has everything to lose and nothing to gain if its price policies emulate the excessive wage demands made by some unions.

True leaders of business sense the danger. They do not want to price themselves out of their markets. They do not want the tag of price hogs. They do not want a buyers' strike. All management must practice the self-restraint which characterizes the wisest leaders among us.

### What Wasn't Done

Virtually all responsible economic analysts agree that if direct price control is eliminated and nothing else is done, prices will move upward. The only serious disagreements are: How far? And for how long?

Some careful and competent forecasters believe that, if all price control is lifted, the official cost of living index will shoot up at least 25 per cent within a year. Some of them think that wage rates will chase right after prices, forcing new price increases until the whole operation ends in a dizzy crash.

Others agree that prices will go up all right, but they think that increased production, made possible by disentanglement from OPA red tape, will bring them down again fairly soon.

Recent developments seem to support those forecasters who think that wage increases would chase right after price increases and thus keep "the inflationary spiral" spinning toward a ghastly fall. Unions already agitate for a new round of wage increases to offset price increases which have occurred in the few months since the last round of wage increases.

Therefore, the prudent course would have been to clean up the OPA price control system, to keep it in place for a limited period as a stop-gap, and, meanwhile, to arrange to replace it with more fundamental controls, PROVIDED the federal government itself stopped promoting excessive wage increases. *The greatest single contribution to the wrecking of the OPA has been the holes driven in price ceilings by government-promoted wage increases.*

But now the stop-gap is being eliminated, and the fundamental controls are not in place. Their erection becomes urgent.

### The Basic Task Now

The danger that prices and wages will get to chasing each other around a ruinous spiral arises, of course, from the accumulation during the war of an enormous sum of money that could not be spent because about 40 per cent of the nation's production was being devoted to war. Men were paid wages and profits for making artillery shells. The shells were exploded. The money remains. It has piled up until the people's backlog of cash spending power, in one form or another, exceeds $225 billions—three times the total in 1939.

More than that, banks hold $115 billions of government securities—a sixfold increase since 1939. These securities can serve as the basis for an expansion of bank credit of many times their volume. A dollar of bank credit will, of course, buy as much as a dollar of cash.

The first and basic task of preventing runaway prices is: *Get this huge accumulation of purchasing power, actual and potential, under some kind of effective control.*

A second task is to see that no unnecessary additions are made to the flood of purchasing power overhanging the market. A third task is to get the productive machinery of the country running at top speed so that it can take up the accumulation in an orderly way, not in a boom-bust sequence. We shall talk here only about the first two of these tasks.

Are there ways of getting at the root cause of a disastrous wage-price spiral which are being neglected? There are many of them. Attention has been distracted from them by building up the battle over OPA as the Armageddon of price stabilization. It is important. But it is not Armageddon. If everything that Mr. Bowles and his associates want done by way of price control legislation were done, the problem of price stabilization would still remain unsolved in the continued absence of a program to deal effectively with root causes.

### Basic Remedies

Here is a rough outline of the key elements of a basic program.

1. Cut public expenditures to the bone and let tax revenues accumulate as business volume increases—perhaps broadening the tax base at the same time.

Now, if ever, is the time to run a surplus and to use it to retire debt. Immediate upward pressure on prices would thus be removed and the burden of carrying debt when the going gets tougher later on would be relieved. A $10 billion surplus of federal, state and local revenues during the next year might not be too much.

An increase in social security taxes, as the House Ways and Means Committee proposes, offers one of a number of good ways to increase revenues. Deferring public works not immediately needed affords one of numerous ways by which substantial cuts in expenditures can be made.

2. Tighten the terms on which installment credit is available for the purchase of houses, automobiles, and other consumers' goods.

Allowed to run a free course, expansion of credit to buy houses and durable consumers' goods might easily add $15 billion to consumer purchasing power next year. No such injection of credit is needed now. The more a man buys "on time" the more cash he keeps to spend on something else. For most products the cash market alone is more than big enough to keep producers busy and customers healthy.

3. Restore to the Federal Reserve system its lost control over the supply of credit by limiting the opportunities for credit expansion now afforded by huge bank holdings of government securities.

The specific measures needed are highly technical, but are agreed upon by banking experts as both feasible and fair. The important thing for the public at large to do is to recognize that we are, in effect, sitting on a powder keg with lighted match in hand until the measures are taken.

4. Revive a vigorous campaign to sell government savings bonds and other government securities to the public.

Sale of government savings bonds cuts down current consumer spending. It also allows the Treasury, if government spending is held down, to retire government bonds which the banks hold. Thus, it simplifies the problem of keeping bank credit within safe bounds.

5. Prevent a speculative inventory boom of the sort which preceded the post-World War I business collapse in 1920-21.

This involves a continuation of the loose controls of inventories now exercised by the government. In more important degree it involves well informed cooperation by bankers and business men to keep inventories from being expanded unnecessarily.

6. Maintain controls on exports in order to keep within reasonable limits the impact on our market of huge foreign demand.

Emergency foreign relief requirements must be met. But foreign demand which is enormous apart from relief requirements must be kept under control until the danger of having it send prices of export products soaring is past.

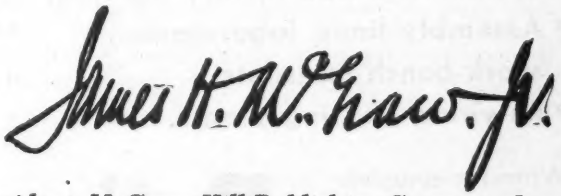
### Breathing Space for Business

This program would deal with causes, not symptoms. Hence, if promptly and efficiently installed, it would do a far better job of keeping the general level of prices and wages within tolerable limits than the OPA type of price control ever could have done—even if OPA had not been so often and so badly mismanaged. The program would also do this without tying up American business in a myriad of irritating and discouraging individual regulations. It would establish broad bounds within which business enterprise would be free to be itself, not a branch of bureaucratic enterprise.

The program proposed here also has the major virtue of flexibility. If prices start to reverse their present upward course within another year, the major parts of the program can be adjusted or removed quickly.

It would be gratifying to suggest junking at once all arrangements designed to place limits on price movements, even broad limits of the sort here suggested. But to do nothing while OPA falls apart, would be to run the grave risk of a runaway of prices and wages which, in the inevitable collapse, would do irretrievable damage to the business community and to the whole nation.

The risk is not worth taking.



*President, McGraw-Hill Publishing Company, Inc.*

THIS IS THE 49TH OF A SERIES

# The New 2x2 *Surfaceduct* will do the job

*Surfaceduct* for

- **Feeder and distribution systems.**
- **Commercial and factory lighting.**
- **Assembly lines, laboratories, work-bench tools, etc.**
- **Rewiring existing plants.**

**National Electric Surfaceduct is a 2-piece, general purpose, electrical raceway.**

**No fishing . . . lay in the wires . . . snap on capping. A principle pioneered by National.**

**Unique bridge provides firm anchorage of capping and devices.**

**8 device covers accomodate over 300 manufacturers devices.**

**Designed for loads up to 60 amps.**

**Gray baked-enamel finish.**

**12 simple fittings meet all job requirements.**

*Sold exclusively through electrical wholesalers.*

*Write for complete catalog information*

**National Electric**
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**Box 897 — Pittsburgh 30, Pa.**

NATIONAL ELECTRIC PRODUCTS
WIRING SYSTEMS
WIRES AND CABLES

# JULY . . . . at a Glance

## Hot Water

Last month we discussed the installation of water heaters at points of use instead of storing and piping hot water around. S. C. Sachs, of St. Louis comments, "We wired an old homestead at Holly Springs, Mississippi, and installed five separate electric hot water heaters, one in the kitchen and one in the corner of the linen closet of each of the four bathrooms. The hot water piping was held to a minimum and hot water was available instantly at each hot water faucet. The system proved to be very satisfactory." It's practical, effective and means more wiring. Why don't we do it more often?

## Mark-Up

Part IV of Ray Ashley's series on mark-up on page 56 concludes the most complete and searching analysis of this vital subject we have ever published. We hope that many of our readers have applied the methods and principles of this series to their own operations. If you have, please let us have some comments on your experience.

## Salesmen

Time was, when a contractor signed up a sizable job, he had to carve his way with a hickey through a wall of salesmen, manufacturers' agents and missionaries to get out to lunch. Now he sits in wrathful solitude trying to find one of the aforementioned gentry who will take enough time off from his racing form to write up an order. Material shortage is acute but that's all the more reason for giving the customer every possible help and attention. He doesn't expect miracles. He does expect a fair break on the stuff that is available and when his suppliers give him a conspicuous leaving alone, he has pretty good grounds for suspecting that he isn't getting it.

## Approval

Non-residential building approved by CPA for eleven weeks totaled $1,371,000,000 with $647,000,000 denied. The ratio will be reduced to about ⅓ of all applications receiving approval. That approval rate, however, looks like a 6½ billion year, a very healthy job for the construction industry at any time. While construction controls are deferring a lot of work, materials supply is a much more critical factor.

## Surplus

We hear persistent reports of conduit stacked to the skies, mountains of cable and warehouses full of boxes and fittings awaiting the ponderous machinery of surplus disposal. Some are exaggerated, no doubt, but the present materials famine calls for quick distribution of all surplus resources. Speed is of the very essence of effective and economical disposal. Why not place surplus electrical materials by allotment or consignment with regular wholesalers or contractors where they can flow immediately into productive channels?

## Sports Lighting

Ball players at Yankee Stadium work under illumination intensities of about four times what we consider good lighting practice in offices. The tremendous flood lighting installation just completed at Yankee Stadium by Fischbach and Moore, Inc., electrical contractors, sets a new standard in sports floodlighting, inaugurating the second decade of big league night baseball. Wiring, lighting banks and control offer many interesting sidelines for everyone concerned with sports floodlighting. You'll find the article on page 52. The cover picture this month is also a close-up of one of the towers taken during the wiring installation.

## Maintenance

The tremendous growth in fluorescent lighting in stores and offices has opened up a new market for specialized lighting maintenance service. On page 49 of this issue, Berlon Cooper tells us the story of the fluorescent maintenance service operation performed by the Jack Stone Company in Washington. Cooper followed the trucks around, visited the customers, poured over the records, and has brought together a lot of factual experience material about this operation. It will prove to be useful background and study for anyone contemplating such an organization.

## Display Cases

A difficult and often critically important lighting problem is the illumination of display cases for effective selling. Such "selling light" is assuming a very important place in modern merchandising. C. B. Stiles and G. C. Knapp of Sylvania Electric Corporation describe in "New Light for Display Cases", on page 62, the application of long, slim fluorescent lamps to this type of lighting task.

## Think how the wire that survives such severe hazards can serve you under normal conditions

# Densheath*

Reg. U.S. Pat. Off.

## TYPE T & TW BUILDING WIRE

★ Densheath insulation, a synthetic compound, is remarkably durable because of its great density. Finish is smooth, polished.

★ Highly resistant to moisture, acids, alkalies, chemicals, mineral, animal and vegetable oils.

★ Flameproof—won't ignite, burn or support combustion.

★ Surprisingly pliant. No "spring." Retains sharp bends.

★ Superior to any rubber compound in super-aging qualities, resistance to ozone, oxygen and sunlight.

★ Superior to usual grades of rubber insulation in dielectric strength. Good insulation resistance. Low specific inductive capacity.

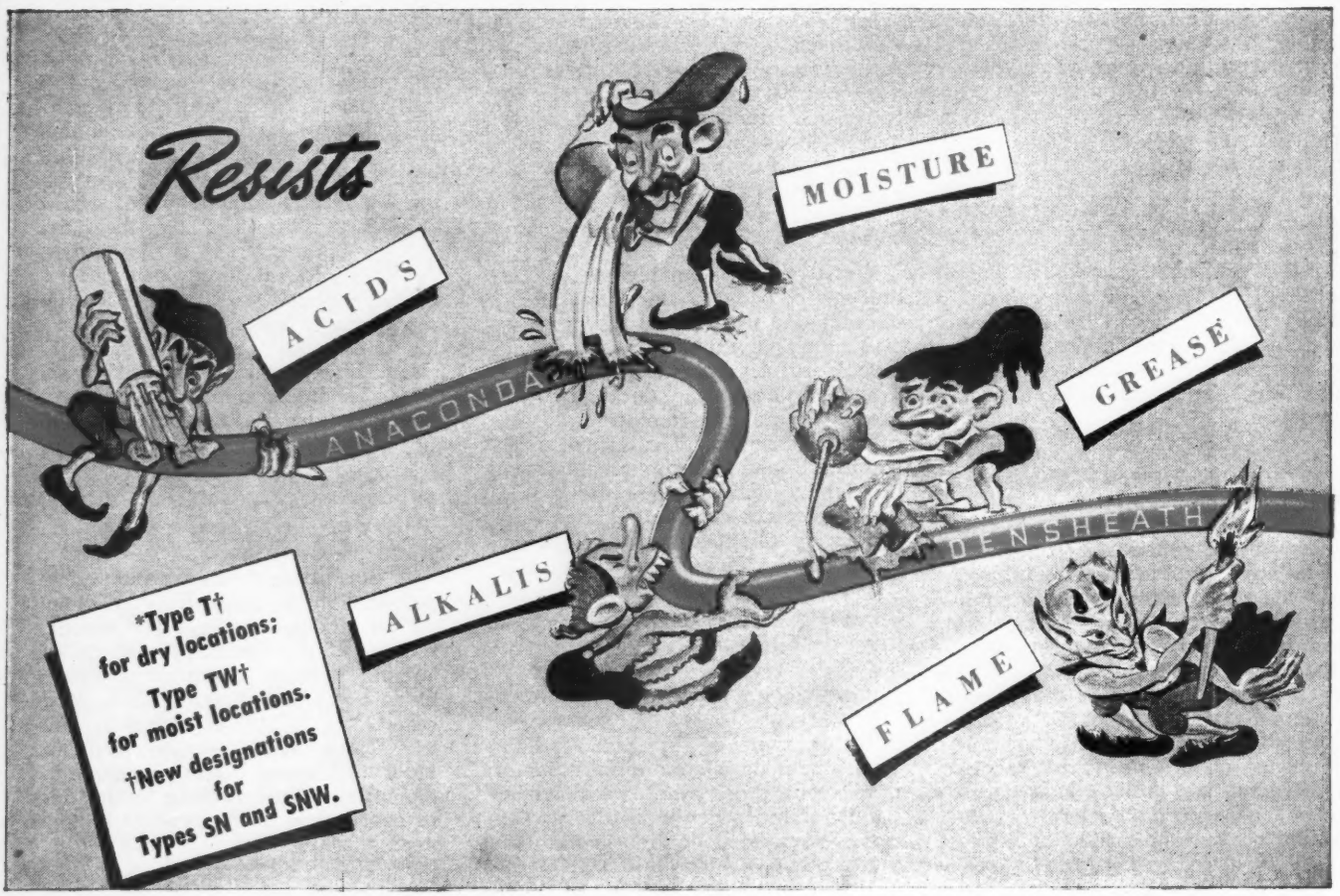
★ Resists reasonable degree of abrasion, tearing, bending and flexing.

★ More circuits per conduit—for new installations, extensions and maintenance.

★ Strips easily; leaves bright conductor.

★ Densheath insulated wire and cable can be used anywhere Type R is allowed.

Densheath is ideal anywhere cables are subjected to extreme conditions. Its flexibility and resiliency fit it for many installations in confined spaces. Available in a variety of colors. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, General Offices: 25 Broadway, New York City 4; Chicago Offices: 20 North Wacker Drive 6; Sales Offices in Principal Cities. 40317




ANACONDA **ANACONDA WIRE & CABLE COMPANY**

# MORE COSTS LESS

Delicate parts on a loaded handtruck were smashed, a sizable expense, and an employee slightly injured in a Jersey plant a few weeks ago because the light over a short ramp was out. Maybe the man was clumsy, as his boss told him in a few blistering phrases, or maybe the maintenance department ought to be collectively fried in its own grease as the man told his boss. We know, however, that six months ago the chief electrician drew up a plan for methodical lighting maintenance and took it to the front office for one of those "good-idea-Jim-but-we've-got-no-money-for-frills" brush-offs.

How many times does management have to pay for the lack of preventive maintenance before it catches on? The above case is altogether too common. The idea that because maintenance costs money, more maintenance will cost more money, is a serious fallacy.

So long as maintenance is a fix-it chore, it is a simple and essential expense. Management can easily understand it and budgets can be drawn up from experience. Preventive maintenance takes more courage and foresight. It is very often more costly in budget outlay. Its benefits to operation, on the other hand, are measurable only in a negative sense. It pays off through stoppages that don't happen, through equipment that doesn't break down, through manhours that are not lost in accidents.

Once established, preventive maintenance, however, quickly proves its value to operation. In one plant, for example, all shut-down time during regular working hours due to failure of machinery is charged to the maintenance department. Consequently, the effectiveness of preventive measures are measurable and readily apparent.

Whether accounting procedure charges shut-down to maintenance or not, that's the way maintenance ought to be appraised in management decisions. The question is not "How much can we afford to pay for repairing a 10 hp. motor?", but, "How much can we afford to pay to prevent failure on a 10 hp. motor application?". The cost of shut-downs production-wise usually makes any conceivable preventive maintenance budget look insignificant.

Many industrials are looking sharply at costs and reviewing plant methods and procedures right now. Preventive electrical maintenance offers one long term economy that always pays off.

Wm. F. Stuart

**Electrical Contracting**

JULY, 1946

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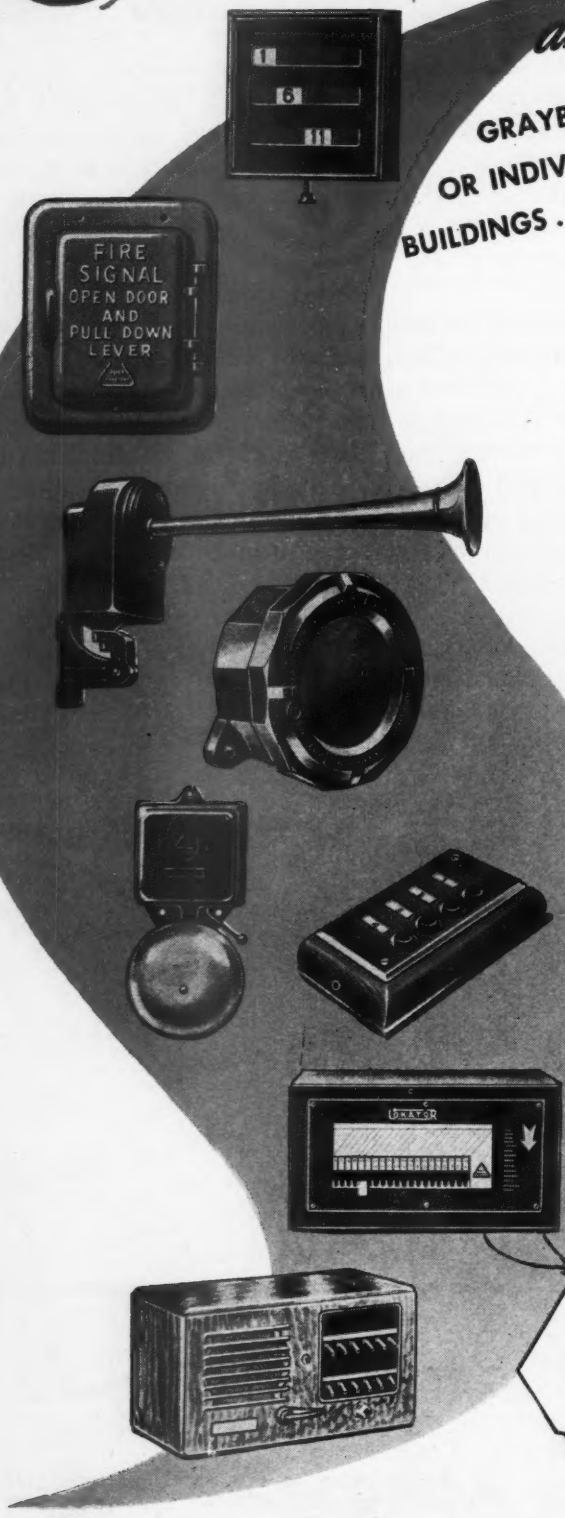


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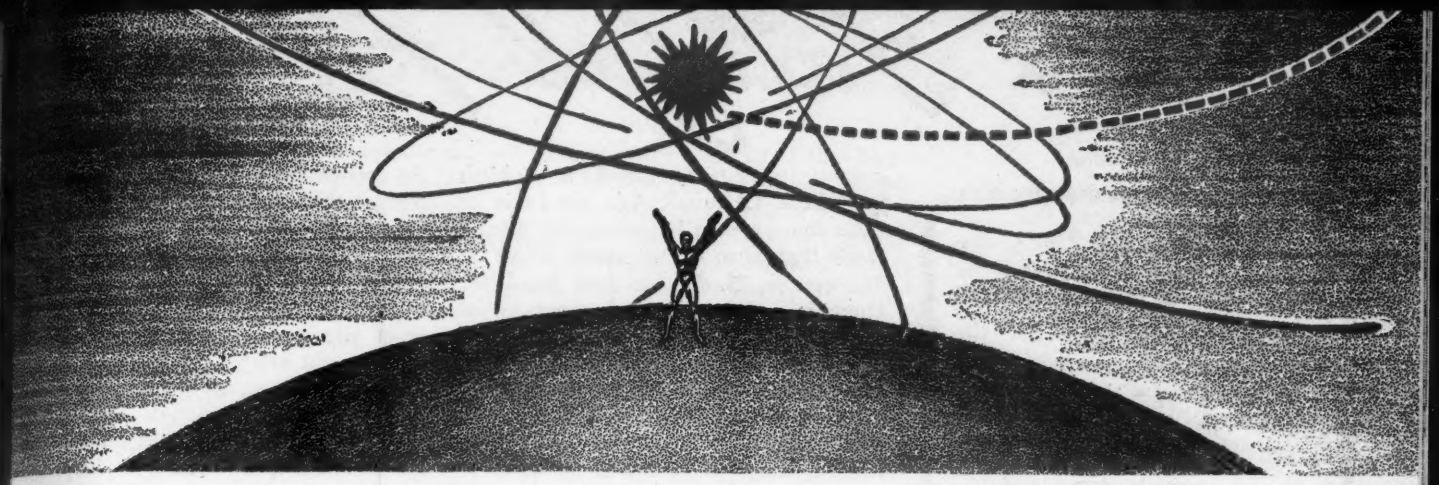

# MAN vs ATOM—YEAR 1

**WHEREIN WE SIGNALIZE THE FIRST ANNIVERSARY OF THE ATOMIC AGE, CONSIDER THE ALTERNATIVES INHERENT IN BOTH GOOD AND EVIL POTENTIALITIES OF NUCLEAR FISSION, THEN VENTURE A GLIMPSE INTO THE FUTURE**

A YEAR AGO, July 16, 1945, at Alamogordo, New Mexico, man created the first atomic explosion. Most impressive events diminish in stature as they recede in time. This one grows bigger with each passing day. It truly marked the beginning of a new age.

As Year 1 of the Atomic Age ends and Year 2 begins, we are engaged in three portentous projects.

At Bikini Atoll we are detonating the fourth and, possibly, the fifth atomic explosions in the history of the world.

At Oak Ridge, Tennessee, we are building the first atomic energy plant for peaceful purposes.

Most important, in New York we and all the other United Nations are engaged in the first attempt to subject atomic energy to international control. Literally, the fate of the world hangs on this attempt.

As this introduction is written, the United Nations Atomic Energy Commission has just begun its work. People everywhere pray for its success—for their own sake, but even more for their children and for their grandchildren. If this Commission fails let everyone everywhere be warned: the world has taken a step toward destruction.

As we enter the second year of the Atomic Age, the nations of the earth are embarked on an atomic armaments race. There is no blinking that fact. We have had official notice served on us. Therefore, we must understand that unless the United Nations Commission can arrest the drift of events, we are moving toward a horrible war. The Commission must succeed.

The American delegate, Mr. Baruch, has brought to the Commission an ably thought out plan. It would internationalize nuclear science, and release for mankind the beneficent applications of atomic energy. But it would "control" atomic bombs only to the extent of giving the world brief warning of any nation's preparation to use them, so that we might have foreknowledge of disaster.

Therefore, the real and enormous task before the world becomes clear. We must end war. No other control of atomic weapons exists. If war comes, atomic weapons will be used. If they are used, our children who survive will curse their fathers. Understanding the consequences of failure, we *must* succeed.

Because we cannot succeed without knowledge, I have asked my associates at McGraw-Hill to condense into the following pages what we know at the close of Year 1 about this great new atomic force—its basic science, its possible uses and its political repercussions.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

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# This Fateful Atom...

LOOKING BACK twelve months to the birth of Year 1, Atomic Age, we begin to sense the majestic import of the atomic bomb that blasted the naked desert at Alamogordo, N. M., on July 16, 1945. There man first shattered atoms in an explosive *fast-chain* reaction. Then came Hiroshima and Nagasaki.

In every case the fateful atom was either uranium 235 (U235), or plutonium derived from the action of U235 on U238. Every pound of U235 atoms split in these unprecedented blasts yielded the energy of 11.4 million kilowatt-hours, or 1400 tons of coal — slightly more for plutonium.

No matter where one mines uranium ore, the purified natural uranium (Fig. 1) always contains 99.3% of the "garden" variety U238, and a mere 0.7% of the precious U235.

An atom is like our solar system. The central sun is the nucleus — a bunched mass of protons and neutrons, each weighing one unit. The planets are electrons. Each proton has one plus electrical charge — each electron an equal negative charge. There must be as many negative electron planets as positive protons in the nucleus. This is also the "number" of the atom. Neutrons have no charge, but add weight.

The atomic number of uranium is 92 because the uranium atom always has 92 nuclear protons and 92 electron planets. The isotopes U238 and U235 differ only in the number of neutrons; U238 has 146 neutrons, and weighs 92 + 146 = 238 units. U235 has 143 neutrons, and weighs 92 + 143 = 235 units.

Ordinary chemical reactions, such as TNT explosions, release only a fraction of the modest energy of the whirling electrons in the outer atom. Nuclear reactions unlock the immensely greater energies which bind together the nucleus.

Even the gentle tap of a slow-moving neutron bullet will split the atom of U235 or of man-made plutonium into two medium-weight atoms, yielding also one to three spare neutrons plus energy. Thus these *fissionable* materials supply both their own bullets and a highly sensitive lot of high-explosive targets — a perfect setup for a *chain reaction* (Fig. 2).

Chain reactions work like chain letters. Neutrons from one nuclear explosion hit and explode other nuclei. But, since atoms are mostly open spaces a chain started in a small block of U235 or plutonium quickly dies out because most of the released neutrons escape from the block.

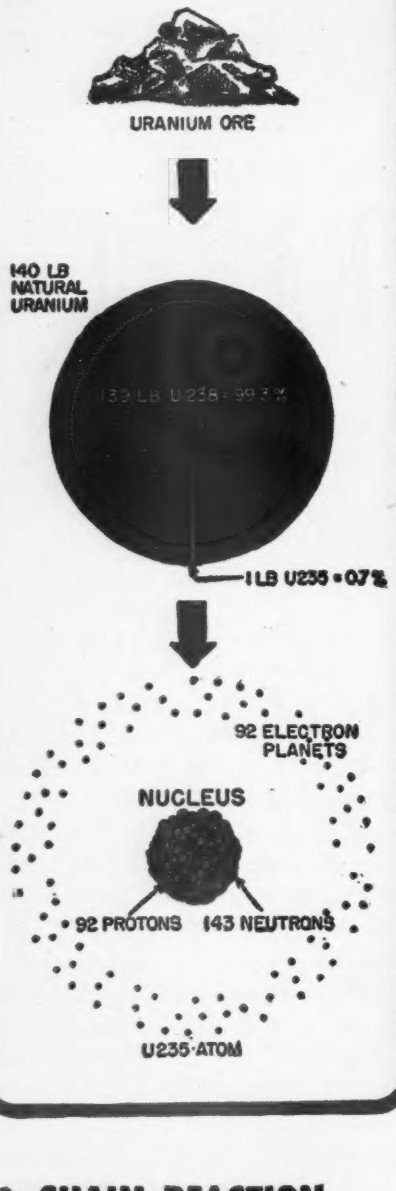
The bigger the block, the smaller will be the percentage of escaping neutrons, and the more left to split other nuclei. When the block is rapidly built up beyond a certain secret size the fragments of 1000 nuclear fissions split many more than 1000 additional nuclei. Then fissions multiply geometrically, and the block disintegrates with explosive speed and violence — as in a bomb (Fig. 3).

This bomb explosion is a fast-neutron chain. For economy and ease of control, uranium piles for the gradual release of nuclear energy for commercial purposes will normally use a lean fuel — that is U235 or plutonium diluted with U238, thorium or other less costly materials.

To maintain a chain reaction such piles must be large and artificially stimulated by using carbon blocks or some other *moderator* (Fig. 4) to slow many of the neutrons. Slow neutrons make more hits than fast neutrons because there is more time for them to be swerved from a straight path by the attraction of nearby nuclei, as shown below.

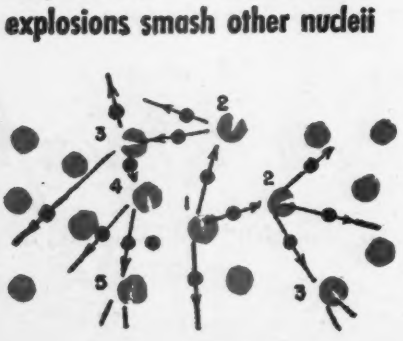
## 1 ORE TO U235

**Only 0.7% of natural uranium is U235**



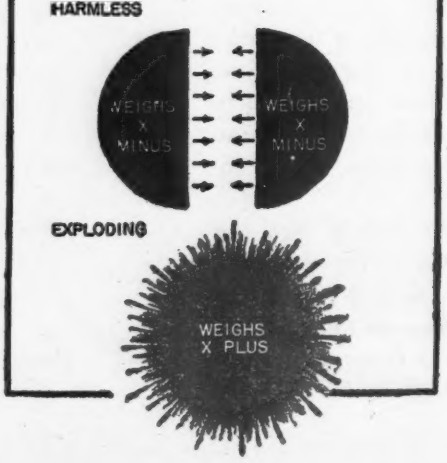

## 2 CHAIN REACTION

**Fragments from earlier nuclear explosions smash other nuclei**



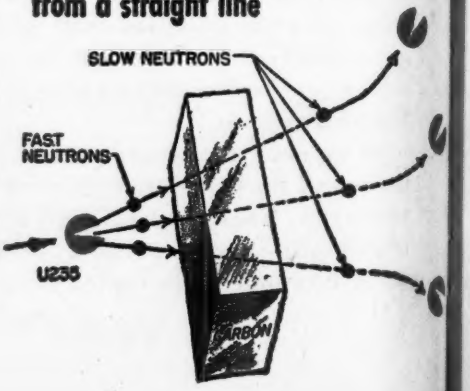

## 3 WHY BOMB EXPLODES

**When block of rapidly assembled U235 passes secret critical size it explodes spontaneously**




## 4 SLOW NEUTRONS MAKE MORE HITS

**A slow neutron is more easily swerved from a straight line**



# ...can Serve Man...

THE FATEFUL U235 ATOM can serve man as a new, compact source of heat energy for power generation, comfort heating or industrial processing. Peacetime applications of atomic energy will use dilute U235 or plutonium as a "fuel," mixed with carbon or some other moderator to slow some of the neutrons and thus keep the chain reaction going.

The diluting agent may be either U238 or thorium, or both. These will do double duty, because neutron bullets convert U238 into the energy-yielding plutonium, and thorium into U233, which may prove equally serviceable.

Thus the commercial piles of the future will "burn" U235 to make other atomic fuels, plutonium and possibly U233, which in turn will deliver heat energy to the pile. In that way it will be possible to get from the pile far more heat than the equivalent of 1400 tons of coal for each pound of U235 split. This highly attractive prospect will speed the day when nuclear energy can compete with coal.

While already mechanically obsolete, the piles making plutonium for bombs at Hanford, Wash. (Fig. 1) reveal the basic principle on which future piles for power and heat will operate. The heat now wasted in vast quantities will be put to work. The plutonium, now removed for bomb manufacture, will be returned to the pile (or left in) as supplementary fuel.

### ATOMIC POWER

The possible everyday applications of nuclear heat pictured in Fig. 2 have been recognized from the very first day of the Atomic Age. Year 2 will see the building of the world's first atomic power plant (a pilot plant) at Oak Ridge, Tenn.

Beyond question such installations will produce power, but it may be years or decades before they prove economical. To compete with conventional plants the piles must first be redesigned to run at temperatures high enough for good power-plant efficiency. Also the techniques of operating piles by remote control through the heavy radiation screens must be radically streamlined.

The Hanford piles run on natural uranium containing only 0.7% of U235. The typical commercial atomic power plant of the future will use more than 0.7% of U235 or plutonium, but less than 50%. This will avoid both the low efficiency of the too-lean mixture and the excessive fuel cost of the rich mixture. It will permit piles of moderate size and take maximum advantage of U238 and thorium as potential sources of plutonium and U233.

One should not expect U235 to replace coal generally in this generation, although a few central power stations and ships will try it out before Year 10 of the Atomic Age. Plants far from traditional sources of fuels may turn much sooner to uranium and thorium as concentrated heat sources, that may easily be transported even to remote corners of the earth.

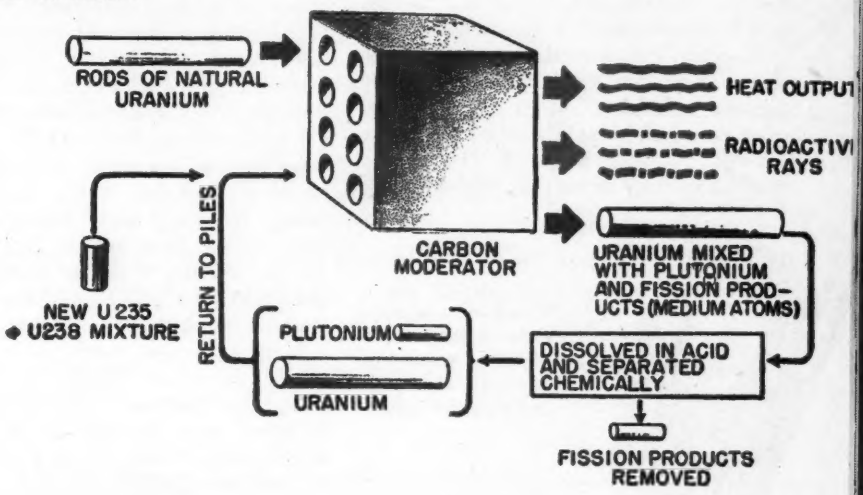
Atomic power, in forms now known, is impracticable for automobiles and small airplanes, because of the large initial investment in uranium and the need to carry 50 tons of shielding to protect riders and pedestrians against the deadly radioactivity accompanying nuclear fission.

### RADIOACTIVE ISOTOPES

More immediately important than the heat and power applications of nuclear energy are the services that the radioactive byproducts of pile operation can render. Because these materials act chemically like their ordinary non-radioactive cousins, but can be followed and detected easily, they are expected to play tremendously vital parts in medicine and biology. For more details, see the last page of this section.

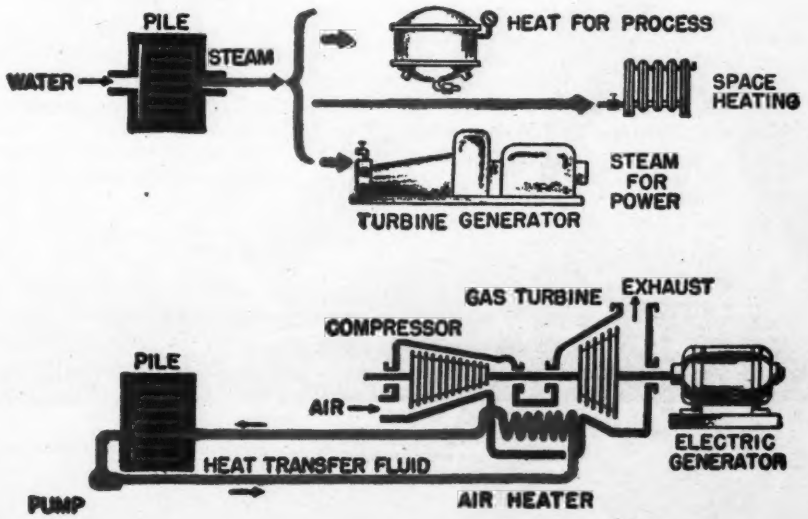
## 1 SLOW-NEUTRON PILE

**Can make plutonium for bombs—or heat for power, process and comfort**

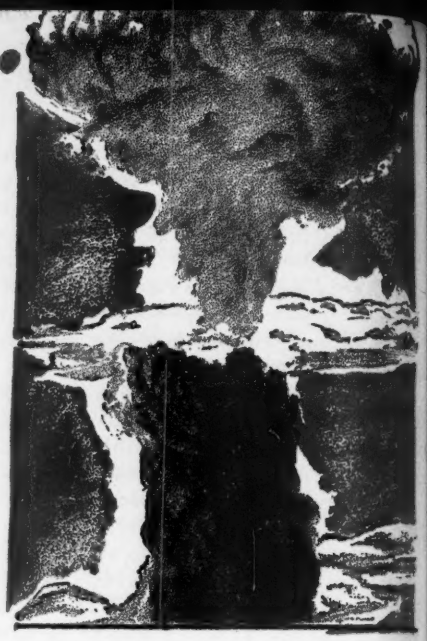



## 2 PRACTICAL APPLICATIONS

**Include steam for turbines, process and comfort heating—also h for gas turbines**



# or Destroy Him . . .



A single improved atomic bomb can devastate ten square miles of city

URANIUM 235 and plutonium are now man's slaves. They will build or destroy as he orders. Man dreads this vast force only because he distrusts himself. War is proof that man in the mass has never achieved self-control. He has always sought better weapons; yet the perfect weapon now brings him no satisfaction for he sees in the atom bomb his own destruction as well as that of his enemy.

The ultimate benefits of nuclear energy may well surpass its present terrors, but the terrors are here now in awful dimension, and man must face them. He must pay this price for unlocking the wealth of the inner atom.

### ATOMIC BOMB

This page, then, is about the atomic bomb. Nothing will be said here that is not either a certified scientific fact or a conclusion shared by the majority of the leading scientists, engineers and statesmen who have studied the matter.

As already explained, an explosive nuclear chain reaction spontaneously sweeps through a block of U235 or plutonium when the block is rapidly enlarged beyond a certain "critical" weight X. That weight is still a military secret; the official Smyth report vaguely suggests that it is more than 4 lb and less than 200 lb. Each piece of U235 in the dormant bomb must weigh less than X. At the desired instant of explosion the bomb mechanism assembles these pieces rapidly into a single piece considerably heavier than X.

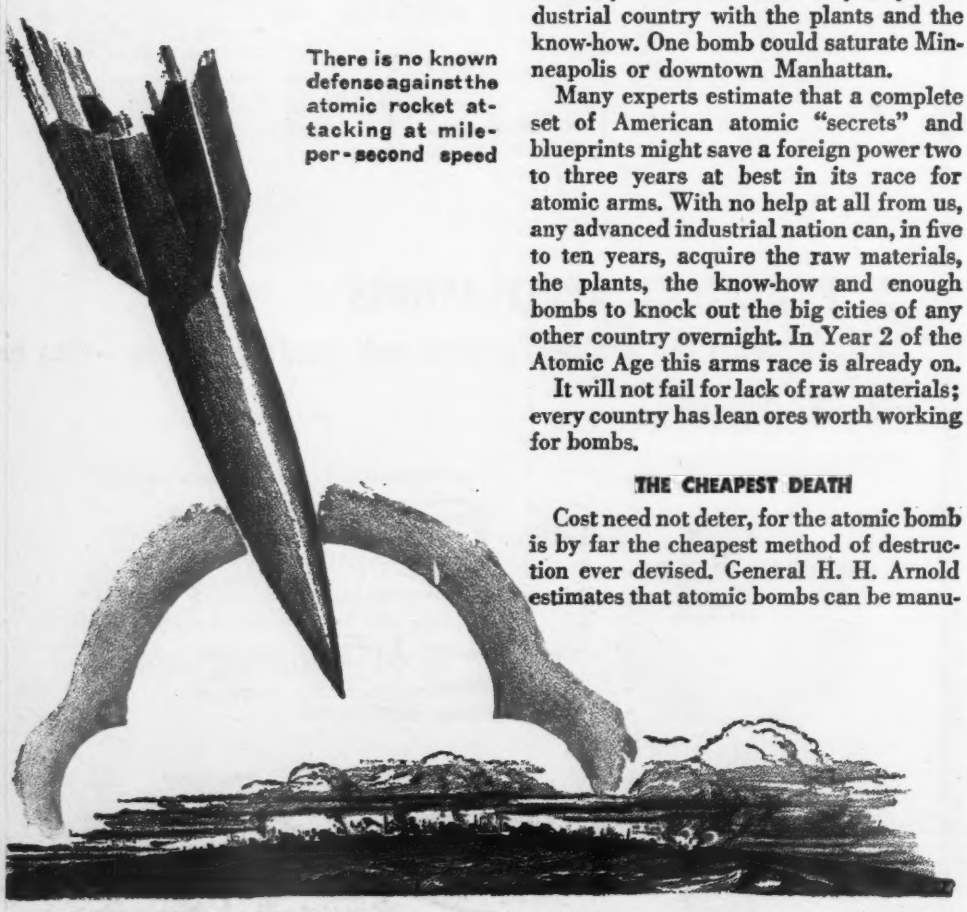
The explosion itself drives the U235 pieces apart, thereby quenching the atomic conflagration before all the atoms are split, so the bomb efficiency is far less than 100%. For each pound of U235 (or plutonium) atoms actually split, the bomb releases the energy of 1400 tons of coal.

This explosion is mainly ordinary heat at work in unprecedented concentration. Bomb metals become incandescent vapor millions of degrees hot. This, and the enveloping sphere of glowing air, radiate a blinding flash that chars human flesh at half a mile and blisters at over a mile. There is a destructive shock wave (sound) and a second-long hurricane of unimaginable force — the outrushing of the expanding heated air. Deadly neutrons and gamma rays speed out from the bomb.

A single atomic bomb killed about 100,000 at Hiroshima. Fewer died at Nagasaki only because the circle of potential destruction included much vacant land. Bombs ten times more powerful can be made by the thousands in any major industrial country with the plants and the know-how. One bomb could saturate Minneapolis or downtown Manhattan.

Many experts estimate that a complete set of American atomic "secrets" and blueprints might save a foreign power two to three years at best in its race for atomic arms. With no help at all from us, any advanced industrial nation can, in five to ten years, acquire the raw materials, the plants, the know-how and enough bombs to knock out the big cities of any other country overnight. In Year 2 of the Atomic Age this arms race is already on.

It will not fail for lack of raw materials; every country has lean ores worth working for bombs.



There is no known defense against the atomic rocket attacking at mile-per-second speed

### THE CHEAPEST DEATH

Cost need not deter, for the atomic bomb is by far the cheapest method of destruction ever devised. General H. H. Arnold estimates that atomic bombs can be manufactured *and delivered* for less than $500,000 per square mile of destruction.

Don't be misled by the two billion dollars America spent on a project that dropped only two bombs on the enemy. New plants can be built at a fraction of wartime cost, and the investment spread over thousands of bombs, not just two.

### NO DEFENSE

So the bombs can be made in ample quantity and paid for, but can they be delivered? The answer is: "Yes; by the time the bombs are ready they can be delivered anywhere and overnight." If the defenses of the target country are weak, piloted planes can get through in ample number. Ten percent would be enough.

For more effective delivery radio-steered pilotless planes and rockets can carry the atom bombs faster than sound. Such weapons will be almost untouchable by either antiaircraft artillery or manflown fighters.

Greatest threat of all will be the transoceanic rockets. The German V-2 rocket, which never once was stopped by Britain's defenders, points one way. It needs only transatlantic range (with atomic propulsion) and an atomic bomb in the nose. Forty-six feet long, loaded with 7500 lb of alcohol fuel and 11,000 lb of liquid oxygen, the V-2 of World War II rose 60 miles in the air and arced 200 miles in five minutes to deposit one ton of TNT in London.

Seeing so many strange things come to pass, the man in the street cannot distinguish between possible miracles and the impossible variety. From the very start of the Atomic Age he has been hoping for a "ray" that will explode the atom bomb far off. Competent scientists and engineers say that cannot be.

The only way to bring down a 3500-mile-per-hour rocket at a safe distance is to chase it with your own 4000-mph rocket. You can't win at this game often enough to establish ironclad protection.

The only specific defense against the atomic rocket known in Year 2 of the Atomic Age is to disperse all cities and put key industries underground. This would be very costly in time, money and national morale.

#### MORE AND BETTER BOMBS?

Some will ask whether the U.S., as the most powerful industrial nation, could not build more and better bombs and carriers than any other nation. Probably yes, but there is still no real security. If the "weak" opponent has enough atomic weapons to destroy us once, what advantage is there in being able to destroy him twice?

Shooting first could protect us now, but not after the world is atomically armed. If we were to destroy the enemy's cities, we would probably miss his well-concealed and protected bomb magazines and rocket launchers. A few minutes later he could return the atomic fire. In brutal simplicity, that is the picture of future atomic war. Everybody loses.

At this point one grasps at another straw: "If everybody is to lose who would be so foolish as to start an atomic war? And didn't the Germans refrain from using gas for a similar reason?" Possibly yes. It *may* work that way. But in a world atomically armed to the teeth some nervous finger *may* pull the fatal trigger.

#### ONLY ONE WAY OUT

Throughout history each new offensive weapon has called out its appropriate defense. But now the offense leaps centuries ahead in a single bound and the defense lies almost helpless everywhere, unless some technical protection, unknown as Year 2 begins, can be devised.

The situation is extremely dangerous. There is no clear way out except through some sort of international action first to stop the atomic arms race and, before it is too late, to hobble war itself.

Can it be done? Perhaps not, but there is no alternative except atomic chaos.

# ...so he faces the Atomic Dilemma

THE NUMBERED statements that follow in somewhat logical pattern are too fateful to be accepted on anybody's say-so. Every reader should test them in the light of his own information and understanding.

The points below sum up the conclusions of the previous article — and these in turn reflect a great mass of thought and discussion among leading scientists, engineers and statesmen close to the problem. To an amazing degree they concur on both facts and conclusions. For authoritative statements of their line of thought, in detail not possible here, the reader should see the recent book, *One World or None.*

## THE DILEMMA

**Nations must either face the probability of an atomic World War III, which would surely be the most deadly in history . . .**

***Or*, the experts propose, yield both atomic weapons and war potential to international authority backed by superior force.**

### What the Experts Say

1. In five to ten years any major industrial nation can make enough atom bombs to destroy all the major cities of any other country overnight.

2. This assumes no "secret" information or other help from us.

3. The necessary uranium ores will be at hand.

4. The cost will not be too high.

5. The bombs produced can then be carried thousands of miles by bombers, or by atomically powered guided missiles moving faster than sound.

6. There will probably be no effective military defense against such weapons.

7. Dispersing cities, and putting key industries deep underground, will give some protection if accomplished in time, but at incredible cost in money and human discomfort.

8. In a world atomically armed, nations can probably protect their bomb stocks and rocket launchers from enemy assault.

9. If so, nation A can destroy the cities of any other nation B, after which B's rockets will destroy the cities of A. Shooting first will not win an atomic war.

10. This knowledge may not restrain the trigger finger of a suspicious power.

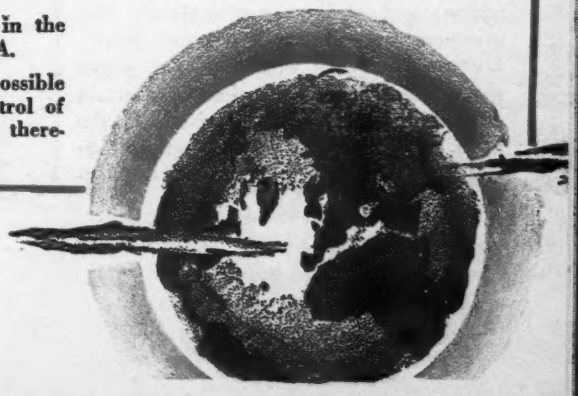
11. Having more and better atomic weapons than the other fellow won't help much if he has enough to destroy us. No use to kill a man twice or rebomb urban ruins.

12. Every nation is vulnerable in the Atomic Age, including the U. S. A.

13. National security will be impossible without (first) international control of atomic arms and (not too long thereafter) international control of all war potential, both backed by superior physical power.

14. If action to this end is long delayed, it may become impossible to halt the atomic arms race already started.

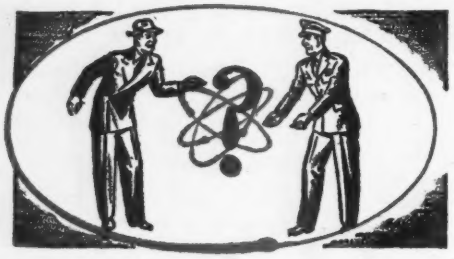
15. At best, the necessary degree of international control, with some real delegation of national sovereignty, will be a revolution in human affairs. It may prove to be humanly unobtainable at this time. If so, men and women everywhere must face the probability of an atomic third world war—by far the most destructive in all history.



In this atomic age no nation can be safe through its own unaided might

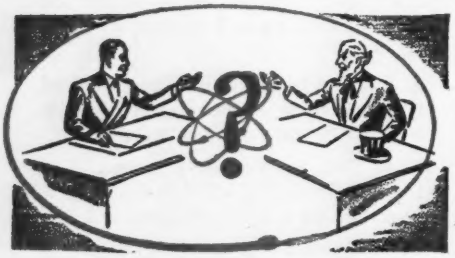
# ...and the Great Debate unfolds

ATOM YEAR 1 has probably been marked by more debate on a single subject than any other twelve months in the world's history. Social, economic and political as well as purely technical issues have been pressing for realistic solution. Let us look at these issues and see where we stand:



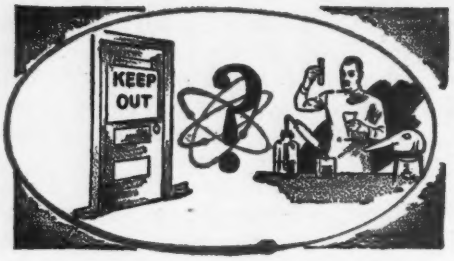
## CIVILIAN VS. MILITARY

Because the atomic bomb is the world's greatest weapon, the armed forces would like to control it. But because atomic energy can also be used for peaceful, beneficial purposes, civilian control seems equally essential. These conflicting viewpoints had their strong proponents before the Congress which finally reached a fairly satisfactory compromise in the Atomic Energy Bill of 1946, setting up a competent civil board with which the armed forces will have continuing liaison. As we go to press, just before Year 2 of the Atomic Age begins, this bill has passed the Senate, but there is still a question how rapidly it will be enacted into law.



## PRIVATE VS. PUBLIC

Atomic energy is "too big" and "too hot" to be handled privately. It must be nationalized and internationalized. The questions are *how* and *to what extent.* Fortunately, as the "boxes" on these pages show, there are means that may attain reasonable safety against misuse of the atom, and still do so without public control of many "non-dangerous" applications.




## SECRECY VS. FREE SCIENCE

Throughout the first year of the Atomic Age hot debate has raged around "keeping the secret of the bomb." To prevent potential enemies from making atom bombs some have urged a complete blackout of all phases of atomic energy — even of the scientific fundamentals of nuclear physics. Others have sought immediate and complete disclosure of all bomb "secrets," both scientific and technological. These have held that such information cannot be effectively hidden, that secrecy blocks progress and breeds wars.

A year of debate has brought the great mass of vocal opinion to this middle ground: (1) Ease restrictions on the exchange of basic physical knowledge. (2) Release for industry's benefit many of the devices and methods developed for the bomb project. (3) Hold tight to specialized information on atomic bombs and bomb-material production until international safeguards are fully operative.

## DOMESTIC CONTROL AS PLANNED IN THE ATOMIC ENERGY BILL OF 1946

*McMahon Committee Bill contains the following provisions.*

**Policy.** Declares it the policy of the U. S. to develop and utilize atomic energy to improve the public welfare, increase living standards, strengthen competitive enterprise and promote world peace.

**Organization.** Establishes the Atomic Energy Commission (AEC) of five administrators to direct four divisions on research, production, engineering, and military applications—to work in liaison with three committees from (1) the armed forces, (2) outstanding civilians, and (3) joint Congressional representatives.

**Production.** AEC to own and operate (under management contracts with industry if deemed desirable) all facilities for the production of fissionable materials, such products to be distributed with their radioactive byproducts under license for private industrial and medical research.

**Military Application.** AEC to engage in development work and produce atomic bombs as directed by the President, to be delivered only on his order to the Armed Forces.

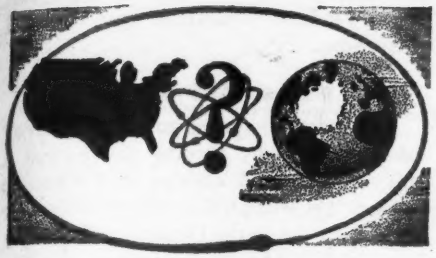
**Industrial Utilization.** Permits AEC to conduct research, design and manufacture equipment for atomic-energy utilization, license its use, produce and sell power obtained as a byproduct in the production of fissionable materials. Directs AEC to give widest safe scope to private initiative.

**Control of Information.** AEC to enforce a ban on the dissemination of restricted data that might be used to injure the U. S. or secure advantage to a foreign nation, yet to provide leeway for ultimately relaxing restrictions as future conditions warrant.

**Patents and Inventions.** No private patents permitted for production of fissionable materials or their utilization for military weapons, but AEC will justly compensate for such inventions, when made by private citizens. Patents for non-military applications may be purchased or condemned by the AEC only when public interest is affected.

**Appropriations.** "Such sums as may be necessary and appropriate to carry out the purposes and provisions of the act" *plus* unexpended funds of the Manhattan Engineer District.

# while time runs out



## NATIONAL VS. INTERNATIONAL

Born of nationalism, the Atomic Age began when three nations discovered a weapon that today gives them the greatest military power on earth. The prime question is: Shall the atom remain the servant of its conqueror, nationalism?

During Year 1 of the Atomic Age the Truman-Atlee-King declaration, the masterly report of the State Department's atomic consultants, and the U.S. representative on the United Nations Atomic Energy Commission, have all called for international control of atomic energy. Year 2 will start with no such control. This failure to decide and act is in part a natural result of the extreme difficulty of the problem and the obvious dangers of unwise decisions. Nations everywhere face a triple dilemma in this Atomic Year 2: the dangers of nationalism, the dangers of internationalism, the supreme danger of not being able to make any decision in time to meet the atomic bomb threat.

## INTERNATIONAL CONTROL AS PROPOSED BY THE U.S. TO U.N. ATOMIC COMMISSION

*Baruch statement follows constructive path laid out by Atomic Consultants in "Acheson-Lilienthal Report."*

**The Plan.** The U. S. has proposed that all nations band together to outlaw the use of atomic energy for war and to promote and harness its development for the benefit of mankind. To this end an International Atomic Development Authority would be set up, and to it the U. S. would turn over, at various stages of its organization, all atomic bombs, know-how, raw materials, facilities, and stockpiles of fissionable material. Thus IADA eventually would supersede national authorities on some matters and supplement them on others.

**Owner and Operator.** IADA would take over from national authorities or private ownership full management and control of all atomic energy matters that afford a possible threat to World security. These include:

1. Raw Materials—Supplies of uranium and thorium to be inventoried, controlled, and developed by IADA.
2. Facilities—IADA to control and operate plants producing fissionable materials and to own and control their products.
3. Research—IADA to undertake research and development on all aspects of atomic energy and to possess exclusive right of research on atomic explosives.

**Private Initiative.** Will have its chance to push forward the use of atomic energy for peacetime (non-dangerous) purposes. With IADA providing raw materials and carrying out necessary inspection, national and private enterprise may operate "safe" power piles, and produce and use radioactive isotopes for research, clinical and other applications. Radioactive isotopes produced by IADA also can be distributed for peacetime use.

**The Mechanics of Safety.** No plan is a certain guarantee against future atomic war. This plan should, however, prevent surprise attack with atomic weapons; for IADA is to buttress positive ownership or management controls with wide powers of inspection. Obviously, successful inspection rests on complete freedom of access or egress in any area.

**Sanctions.** At the heart of the plan lies the problem of penalty for violation—a matter for profound statecraft. To the U. S., one aspect of sanctions appears crystal clear: Here is an area where the veto right now held by the five great Powers must be redefined if it is not to be incompatible with the meaning and purpose of the proposed control.

**Leading industrial nations can produce atomic bombs in five years, competent scientists announced after Hiroshima. Already one year of the precious five has been consumed in debate without international action. Soon it may be too late to check the growing momentum of the atomic arms race.**

## TIMETABLE—ATOM YEAR 1

1. **July 16, 1945. World's first atomic bomb detonated in New Mexico.**
2. **July 26, 1945. President Truman and Prime Minister Churchill issue Potsdam ultimatum threatening Japan's destruction if she continues.**
3. **August 6, 1945. Atomic bomb dropped on Hiroshima.**
4. **August 9, 1945. Atomic bomb hits Nagasaki.**
5. **August 11, 1945. Army releases Smyth Report on "Atomic Energy for Military Purposes."**
6. **August 14, 1945. Japan accepts terms of Potsdam declaration.**
7. **November 15, 1945. Truman-Atlee-King issue declaration of intention and procedures looking toward international control of atomic energy by United Nations.**
8. **March 28, 1946. State Department issues Acheson-Lilienthal Report on the "International Control of Atomic Energy."**
9. **April 12, 1946. Manhattan Engineer District announces program for experimental development of atomic power.**
10. **June 1, 1946. "Atomic Energy Bill of 1946" passes Senate unanimously, is referred to House of Representatives.**
11. **June 14, 1946. First meeting of United Nations Atomic Energy Commission (Bernard Baruch as American member). Manhattan District announces availability of radioactive isotopes for research use.**
12. **July 1946. Joint Army-Navy tests of atomic bombs at Bikini.**

# ..but if Man Masters Atom..

IF MUTUAL DESTRUCTION by the atomic bomb can be avoided, the first century of the atomic age will bring immense advances in scientific knowledge, health and living standards. Already many prospective benefits can be outlined, but those we can neither foresee nor suspect may be even more important.

This prediction is grounded in scientific experience; the most fundamental discoveries have always been the most fruitful. The study of molecules gave us chemistry. Faraday's experiments with electricity and magnetism are the foundation stones of the great electrical industry. Can one expect any less from an understanding of the heart of every atom?

### BENEFITS

Atom-splitting benefits clearly visible today fall mainly in three classes: (1) heat and power applications of the uranium piles; (2) general industrial applications of equipment and methods originally developed for the bomb project; (3) chemical, biological and medical uses of the "tagged atoms" (radioactive isotopes) now abundantly available from pile operation.

It is now evident that the energy yield of the U235 in an atomic pile can be multiplied many times by returning to (or leaving in) the pile the plutonium and possibly the U233 produced respectively from the U238 and the thorium in the pile. This is an indirect way to "burn" inexpensive U238 and thorium, and thus greatly extend the supply and reduce the cost of atomic fuels.

### POWER APPLICATIONS

Although present piles run at low temperatures, it is certain that temperatures high enough for the efficient operation of steam and gas turbines will be attained. Already an experimental atomic power plant has been ordered. Atomic power for certain remote installations (say, for heating Arctic airports) may not be far off.

In five or ten years uranium piles will be driving a few experimental ships and submarines. In 20 or 30 years uranium may begin to compete widely with coal as a fuel for suitably situated large central heating and power plants. The 50-ton minimum weight of shielding rules out nuclear power for automobiles and small piloted planes.

### SPECIAL USES

Some day ultra-high temperatures from splitting atoms will be used for special industrial operations on metals and other materials. Even the dread atomic bomb might easily serve peaceful ends — blasting lakes in deserts, changing the course of rivers, leveling mountains.

### INDUSTRIAL BYPRODUCTS

The special industrial equipment and methods developed for the bomb project will find hundreds of important uses — mostly for purposes unrelated to atomic energy. These developments include pumps with neither seals nor leaks, leak detectors of amazing sensitivity, ultratight welding, a portable mass spectograph for quick and automatic gas analysis, new ways of handling corrosive and poisonous materials, new diffusion barriers for the separation of gases and of petroleum products.

### TAGGED ATOMS

Yet more important than any of these, in the long run, will be the hundreds of radioactive isotopes now available as by-products of pile operation. Chemically indistinguishable from the ordinary forms of the elements, these isotopes serve as tagged atoms or "spies" if mixed with common stable atoms of the same species. They "fly with the flock," and can later be identified as surely as banded birds. With these amazing tools of research, the course of any element or compound may be traced through the bodies of men, animals and plants. Similarly, tagged atoms may be used in studying the course of many kinds of industrial and chemical operations.

### BIOLOGY AND MEDICINE

A suspected hyperthyroid condition can be diagnosed by feeding the patient a minute measured amount of radioactive iodine. The click of a "Geiger" counter placed on the patient's neck will tell (1) what percentage of the swallowed iodine concentrates in the thyroid cells and (2) how rapidly that concentration is accomplished — giving a definite indication of the state of the gland.

In similar fashion the radioactive isotopes of hydrogen, oxygen and carbon will trace out the intricate transformations of carbohydrates and proteins in the human body. Radioactive phosphorus will explore the bones. Radioactive iron will show how and where blood cells are formed. Radioactive sodium will time the circulation of blood.

### USES IN INDUSTRY

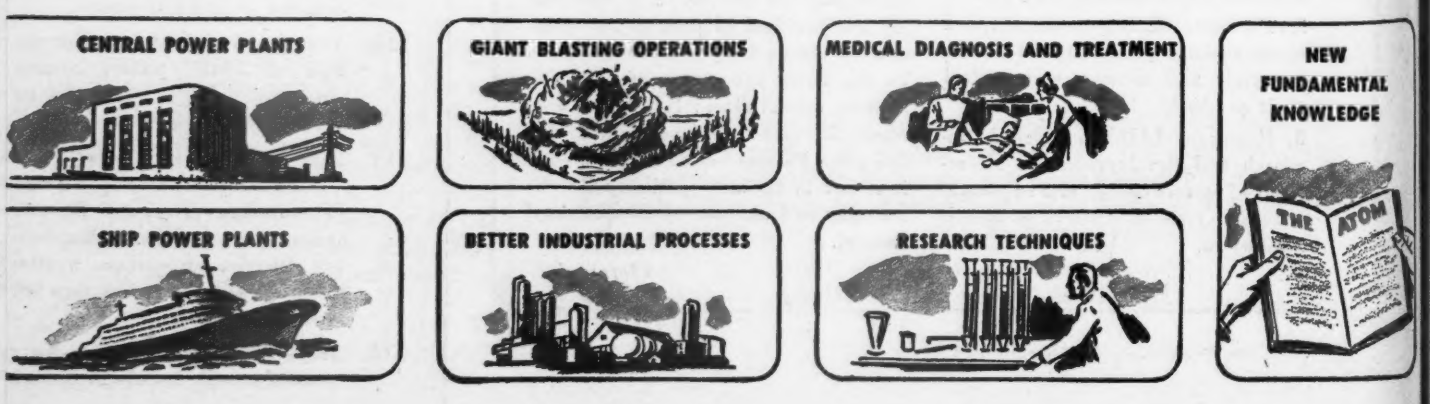
In chemistry the radioactive isotopes will speed the understanding of metallurgical and organic reactions. In industry they will measure flow, detect leaks, and do other useful work.

Meanwhile the uranium piles will be manufacturing certain radioactive isotopes that can serve as cheap but effective substitutes for high-cost medical radium.

### KNOWLEDGE COMES FIRST

It is already clear that the chief benefits of atom splitting will come first as new scientific knowledge rather than as new engines and gadgets. But in the long run man's new understanding of the inner atom will enrich the whole range of human activity. This has always been the case with less fundamental discoveries in science. It can hardly be less with this most fundamental discovery.

## ATOM SPLITTING WILL SERVE MAN IN:



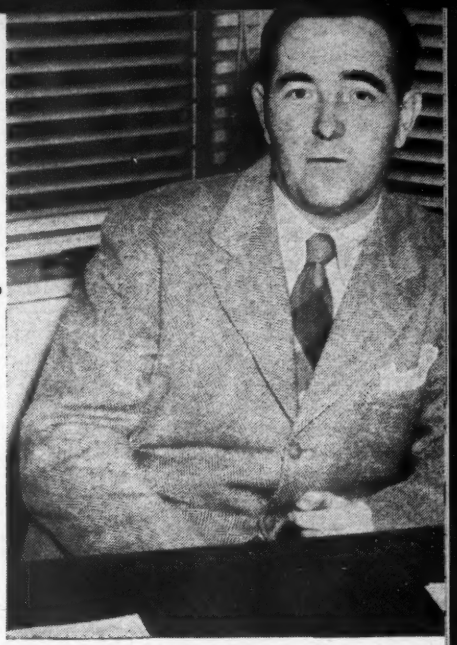


*Fig. 1—Jack Stone believes in specialized electrical services. His firm, The Jack Stone Company, Washington, D. C., now comprises five specialized divisions, including the Lighting and Maintenance Division.*

**How an electrical contractor organized and now operates a successful Lighting Maintenance service.**

# Fluorescent MAINTENANCE SERVICE

**By**
**Berlon C. Cooper**

LIGHTING maintenance is a specialty electrical service. Established as such, it can be made profitable. This has been proved by The Jack Stone Company, an electrical contractor operating in the metropolitan area of the nation's Capital.

Early in 1945, a Fluorescent Lighting and Maintenance Division was organized at the suggestion, and through the cooperation, of Sylvania Electric Products, Inc., using Sylvania's specialized fluorescent maintenance plan as a basis.

Jack Stone, owner of the company bearing his name, believes in specialized services. His organization is now divided into five divisions. They are: Air Conditioning and Refrigeration; Electrical Contracting and Engineering; Neon Displays; Aircraft and Marine; and Fluorescent Lighting and Maintenance. The last division was set up on a specialized basis for two main reasons: first, to keep contract costs to customers at a minimum; and second, to give the customer maximum service at all times.

*Fig. 2—W. W. Langston (right), is manager of the Lighting and Maintenance Division. His sales representative is Harry W. Yohey (left). Both are qualified lighting engineers, and specialists in lighting maintenance problems.*

### The Service

This specialized service consists of the maintenance of lighting equipment on an annual contract agreement basis. It provides maximum efficiency and proper electrical operation of the lighting system under contract. The service includes cleaning of lighting fixtures or equipment every three months (standard basis), or as otherwise specified in the contract. It also includes a thorough check and replacement, where necessary, of defective lamps, sockets, starters, ballasts, wiring and all other parts within the fixture. New lamps are installed throughout periodically, as preventive maintenance against burnout, and to provide maximum light output at all times.

### Cost

Sylvania's recommended basis for charging for this service was adopted. This is a "per lamp per year" basis, and applies to each of the lamps involved in the fixtures covered by the

*Fig. 3—W. W. Langston uses his light meter in closing a Lighting Maintenance Agreement with Jack Berger, Eleventh Street Liquor Store, Washington.*

contract. To arrive at a cost per lamp per year, an analysis was made of local labor costs, types of installations to be solicited, type and make of fixtures most prevalent, typical parking restrictions, lamp life, estimated ballast and starter life, and other similar factors. After careful analysis of these pertinent factors, the following simple schedule of prices was adopted:

| | |
|---|---|
| White or daylight lamps, 15, 20, 30 and 40 watts..... | $3.24 |
| White or daylight lamps, 100 watts ..... | 6.00 |
| Colored lamps, any size or color ..... | 4.20 |

The customer is billed monthly, and bills are payable in advance. A minimum billing of $3.00 was also adopted, since smaller accounts would be uneconomical and non-profitable on the low cost basis established.

### How Service is Sold

Direct mail campaigns are used to obtain prospects, augmented by personal follow-up. The first mail campaign consisted of a series of three letters. A "Request for Maintenance Survey" postcard was enclosed with each letter. A selected list of 1800 names, all customers of other divisions of the company, was used for the first mailing. Over 80 firms returned the cards, asking for a survey and quotation. Personal follow-ups resulted in 50 signed contracts.

Personal calls have resulted in another 109 contracts, giving a total of 159 contracts in effect May 15, 1946. Additional contracts are being signed weekly. The 159 contracts account for monthly billings in excess of $1880, for an average of approximately $12 per customer. The largest contract in effect is for $120 per month, and the smallest (minimum which will be accepted) is for $3 per month.

A second mail campaign to a list of 6000 firms is now being made. The list for this mailing was taken from the classified section of the telephone directory. Customers already under contract were deleted from the list.

The division manager, W. W. Langston, and his sales representative, Harry W. Yohey, make all calls on prospective customers. Each carries a light meter, supply of Maintenance Agreement forms, pamphlets, leaflets, charts, photographs, etc., covering maintenance service. These are all used as selling aids and in explaining details of the service. When a prospective customer is interested in the service, complete surveys are made, covering number and type of lamps, number and type of fixtures, and location of fixtures (such as in basement, on first or upper floors, over counters or desks, in show windows, etc.). In addition, parking facilities, business hours, and other similar details are noted. Quotation is made on the spot, and signed contract obtained whenever possible. If contract is not signed at time of call, the quotation is confirmed in writing. Advantages of the service are again brought to the prospect's attention, in the letter of transmittal accompanying the written quotation.

Months of experience with prospects has given both the manager and the sales representative a broad background of sound sales pointers. Based on the current cleaning schedule, type of fixtures installed and labor used for cleaning, schedule for replacing lamps, etc., each can closely estimate what lighting maintenance is already costing a prospective customer. They can also quickly evaluate the cost of lack of maintenance, in footcandles wasted, and in dollars paid for light which is not received.

Some of the many advantages of specialized lighting maintenance service, which are brought to the attention of prospects, are listed below:

1. Cleaning is periodic.
2. Fixtures are maintained in good mechanical condition.
3. Electrical failures are quickly corrected at no added cost.
4. Work is done by specially trained union mechanics.
5. Hazards of unskilled labor are eliminated.
6. Lamps are replaced periodically.
7. Maximum lighting efficiency is maintained.
8. Owner receives light he pays for.
9. Prompt service is always available.

A fluorescent lighting maintenance service must be sold every inch of the way, in the opinion of W. W. Langston. When the benefits of the service are properly presented, however, and the prospect is assured that the service organization has the know-how, proper equipment, and specially trained men,

*Fig. 4—Michael Zelaski, foreman (center), unloads lamps from truck, while specially trained mechanics John R. Purdy (left) and Wm. E. McIntyre take supplies into the store. Note well stocked truck, with ladders on top.*

owners of lighting systems are quick to see the economies which result from such a service. Proof of this is reflected in the increase of billings, month after month, since the inauguration of this division and this maintenance service.

### Management

Personnel for the division consists of the manager, a sales representative, a foreman and three mechanics. It is estimated that this organization is ample for billings up to $2500 monthly. Addition of two mechanics and the necessary additional equipment will, it is conservatively estimated, permit an additional $1250 billing per month.

Sales promotion by mail, billing, bookkeeping and keeping of records are handled by company office personnel. Once the office routine is established on a sound basis, this work requires very little time.

When a new contract is signed, an Office Record sheet and Mechanics Record form is filled out. The Office Record sheet goes to the bookkeeper, and the Mechanics Record is given to the foreman. The foreman schedules the original clean-up job and assigns the work to the maintenance mechanics on one of the trucks. When the work has been completed, the mechanic fills out a Time and Material form in triplicate (white, blue and yellow copies), and has this form signed by the customer. The yellow copy is given to the customer, white copy is given to the foreman to turn in to the office and routed to the bookkeeper, and blue copy is retained by mechanic. The foreman completes the Mechanics Record card, showing me-

[Continued On Page 153]

THE JACK STONE CO. — 18th Street & Jefferson Davis Highway, Arlington, Va.
(hereinafter called Contractor)

and _____

(hereinafter called Customer)

1. Contractor agrees to render fluorescent fixture maintenance service for the number and types of fixture reversed side hereof, and at the locations shown. Such service will consist of the maintenance of the fixtures in g operating condition, including the replacement of defective lamps and starters and the repair or replacement on the the Contractor's plant of all defective transformers or other parts within the fixtures; and the contractor agrees fixtures every..... months.

2. The customer agrees to notify the Contractor immediately should any of the fixtures or any of the pa to function properly and will not permit any unauthorized person to service the same. The Contractor agrees to of standard repair parts for such fixtures and to make all necessary repairs as may be required from time to ti

3. The custo... to pay the sum of $..... per month in advance, on the..... and every month fo... intenance service specified herein. Default in any monthly payment will rend for the entire unexpi... due and payable forthwith.

4. The contr... to fulfill this agreement, provided such failure be due accident, governme... beyond its control.

5. This ma... months, from t and shall continue... is given in w prior to the expir...

ACCEPTED:

Name _____

By _____

Title _____

Fluorescent Fixture Maintenance Prospect Card

Name _____ Person Interviewed _____

Address _____ Business _____

Total Lamps _____

" Fixtures (open) _____ Price Quoted _____

" Maint. _____

Immediat... Clean _____

Letter _____

Remar... _____

REQUEST FOR MAINTENANCE SURVEY

YES . . . we're willing to have you inspect our fluorescent lighting installation, with a view to possible manpower and money savings in our fixture maintenance. Please get in touch with us for an appointment.

(Because of the large number of new customers just signed up, the number of new surveys, as well as contracts, must be limited.)

NAME _____

COMPANY _____

ADDRESS _____

CITY _____

NO. 3 THIS CARD REQUIRES NO POSTAGE — JUST FILL IN AND MAIL

***Fig. 5—Typical forms used by The Jack Stone Company to simplify operation of its maintenance service. Note simple terms of agreement.***

***Fig. 6—Foreman Mike Zelaski inspects wiring, ballast, and other electrical parts before mechanics begin cleaning the fixture. This is done on an original "clean-up" job, and on interim calls as required.***

***Fig. 7—Maintenanceman McIntyre cleans reflector with soap and water, normally used on all fixtures. Cleaning compounds are used only for some unusual condition, such as cutting grease on fixtures in a restaurant.***

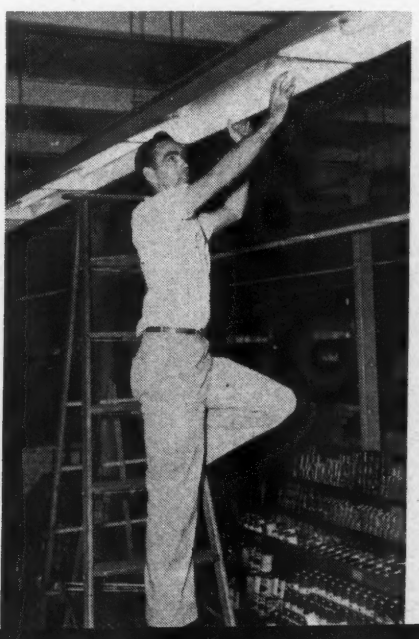
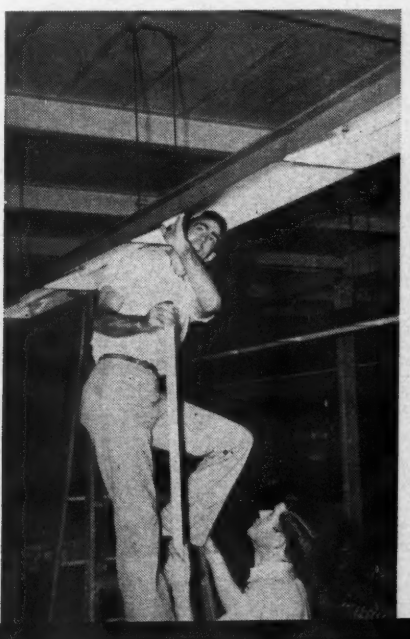


***Fig. 8—John Purdy hands lamp to Bill McIntyre as he completes cleaning a reflector. Mechanics take turn on the ladder, while other acts as helper. Two-man crews have been found adequate for most service jobs.***



# LIGHTS UP...

**By Hugh P. Scott**

THE greatest floodlighting installation in the experience of organized Baseball is blazing down on the three-acre playing field of New York City's Yankee Stadium, inaugurating the second decade of Big League night ball.

More than 1200 lamps with a connected power load of over two million watts and representing an investment of a quarter-million dollars are spreading a brilliant blanket of 200 footcandle light-intensity over the entire freshly-sodded park, the bull pens and players' benches.

Although the lighting intensity on the field nearly doubles existing levels of formerly-installed systems; the revolutionary lamp-housing design, prefocused directional-beam planned lighting pattern and the mounting height of the units combine to achieve glareless, shadowless, daylight-rivaling perfection which may well mark the Stadium as the standard which future installations must emulate.

The completed lighting project is a triple tribute to the progressive vision of Yankee President L. S. MacPhail, the engineering ingenuity of electrical contractors Fischbach-Moore and the extensive research and design of the General Electric Company.

Six steel towers, jointly weighing 345 tons, fabricated by the Blaw-Knox Company of Pittsburgh, are superimposed on the roof of the triple-decked grandstand to hold the mounting framework for the 1245 floodlights. Catwalks behind each tier of lights provide safe, convenient working platforms for periodic fixture maintenance and lamp replacement. The present number of lighting units in each bank varies from 150 to 270 while excess feeder capacity and frame work design provide for the future addition of 132 more units to the combined system. In the event that such an addition should be installed, a total power load of 2400 kw. would be required to light the 1377 floodlights. The lowest tier of floods is 120 feet above the playing field and above this level the lights are mounted in a geometric pattern with 3-foot intervals between horizontal rows and 2-foot spans between

# . . . BATTER UP

**Yankee Stadium floodlighting installation creates new sports illumination standards**

***Colonel L. S. MacPhail, President of the Yankees and the "Father of Major League Night Baseball," can point with justifiable pride to his fourth and greatest floodlighting achievement.***

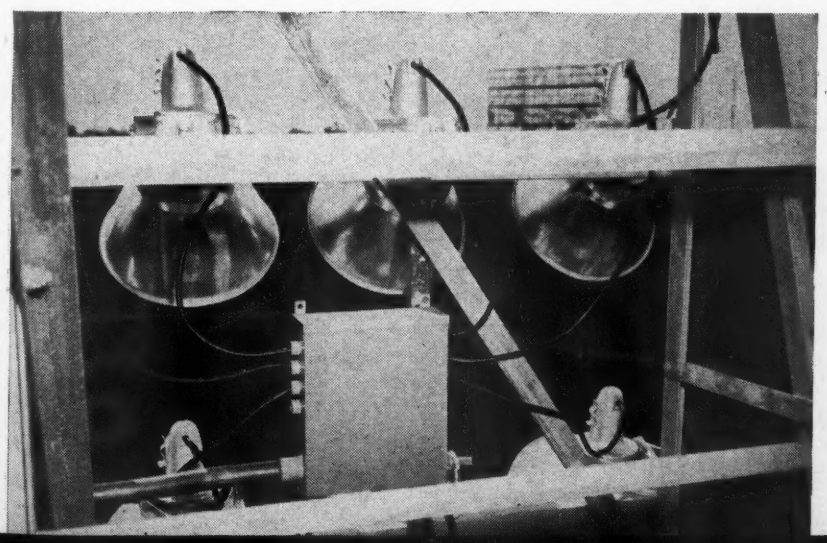
vertical columns. Fifteen miles of wiring and 30,000 feet of conduit carry current to the towers. In order to completely illuminate the entire playing field, the towers are built flush with the outer edge of the roof so that lights may be trained directly downwards without having the light beams impinge on the shelter lip and create shadows.

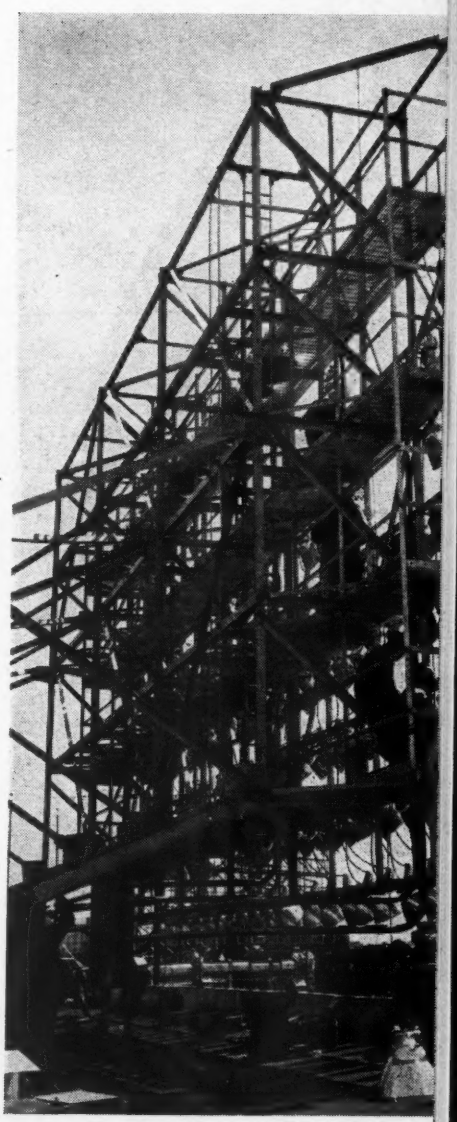
In designing the distribution system, it was necessary to achieve an installation capable of handling more than 2400 kw. This summation included an initial floodlight load of 2170 kw., an anticipated future lighting addition of 230 kw. and the comparatively minor demands of concessionaire elevator service and incidental lighting and power requirements.

Since the only existing service was through an already loaded 500 kva. transformer vault, located opposite column 21 near the foot of tower A-1 it was mutually decided by the engineers of Fischbach-Moore and the Consolidated Edison Company, the utility, to increase the capacity of this existing vault, install two additional vaults to supply towers B-1 and C-2, and establish secondary services for towers A-2, B-2 and C-1. The installed service capacities are 1000 amps. (for towers C-1 and 2), 1200 amps. (B-1 and 2) and 1600 amps. (C-1 and 2). These services are located opposite columns 4, 10, 16, 21, 32 and 35. The capacities of the six service entrances were readily established by totaling the desired tower and non-floodlighting loads. Service locations were selected after studying the utility's primary and secondary networks, connected loads and manhole locations. Engineering responsibility was transferred from the utility to the electrical contractor at the stadium building line.

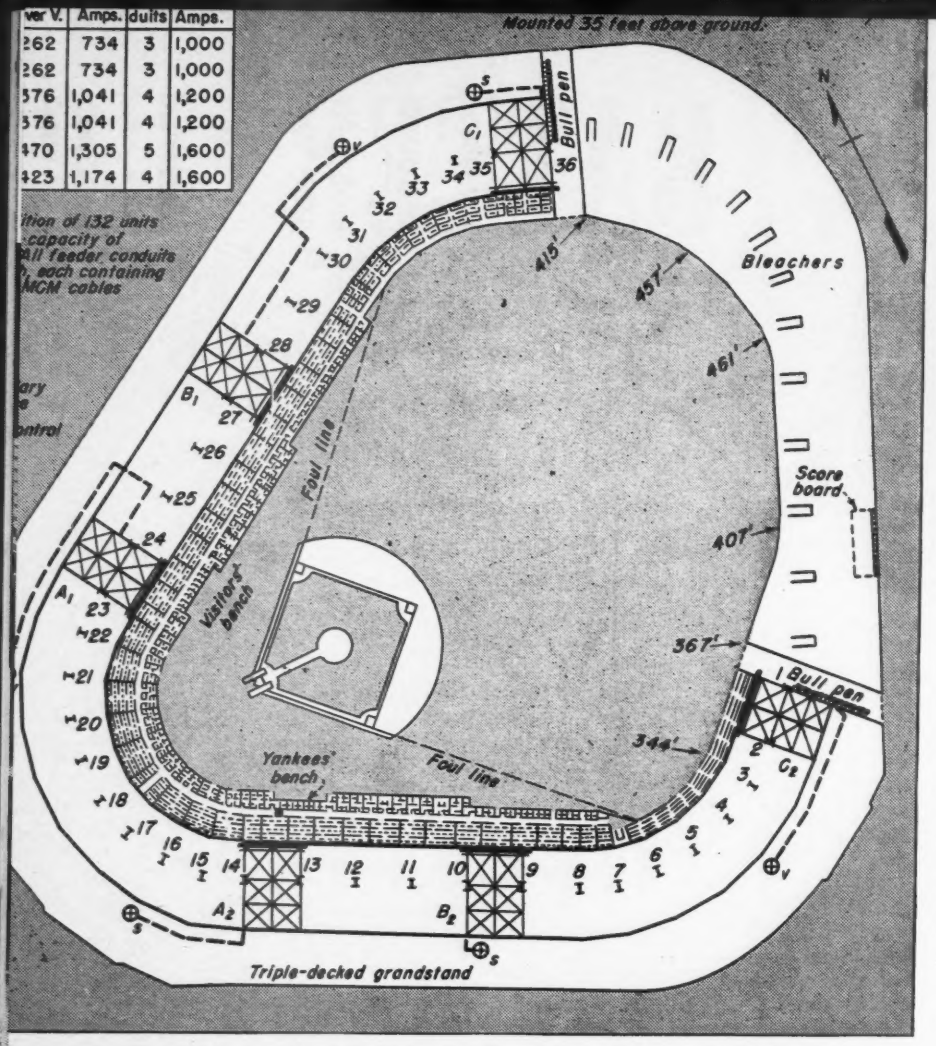
Serious consideration was given to the advisability of carrying high voltage service to the stadium roof where it would be stepped down to an operating level of 115 volts through roof-installed

***Floodlight leads, ready wired through watertight snubbing glands in lamp socket housings, enter lighting panel through hubs and moistureproof stuffing tubes. Each panel can serve 12 floodlights. Clip on socket housings fastens base to mounting yoke during maintenance inspections.***

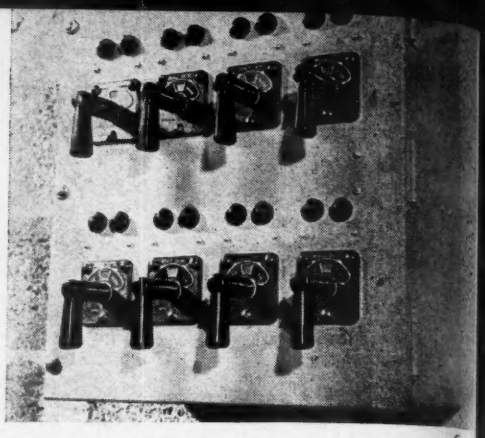




***The six towers, totaling 345 tons, overhang the shelter lip of the grandstand to eliminate light-beam impingement on the roof and to permit even illumination on entire field. Lowest floodlight is 120 feet above playing field. Catwalks behind units provide ready access to lamps.***




***Six towers support total of 1245 floodlights with provision for additional 132 units. Entire field is illuminated to an average of 200 footcandles intensity. Remote control station behind Yankee players' bench controls system.***



***Remote control station located behind Yankee dugout operates entire floodlighting system. Three-way switches turn to trip, close and off positions. Red and green bulls-eye lights indicate whether circuit breakers are opened or closed.***

transformers. After checking the original bending moment diagrams, it was determined that although the weight of towers and lighting units did not violate allowable steel safety factors the additional transformer equipment would exceed these safety limits. For this reason risers were run from ground-based services to roof-located distribution panels.

A typical secondary service installation consists of a combination Pringle service pressure switch and current transformer cabinet, metering facilities and a GE-2-AL-50 remote controlled circuit breaker.

Selection of riser and feeder size was dependent on lamp operating voltage, connected load, length of runs, characteristics of utility supply and allowable voltage drop. To operate the 105-volt lamps at 10 percent overvoltage necessitated a socket delivery of not less than 115 volts, 5 volts below the Edison supply of 208/120 volts. Less than a 3-volt drop between service entrance and distribution panel was achieved by standardizing on 500 MCM cables, four to a run, in 3½-inch conduit. A 2-volt drop from distribution panel through circuit panels to floodlight units was maintained by using four No. 4/0 RW feeders in 2½-inch conduits between distribution panel and splice boxes, and four No. 4 RW feeds in 1½-inch conduit from splice boxes to the 12-circuit lighting panels. The final drop was actually less than the allowable and the resultant socket voltage of 117 volts boosted the lamp lumen output 38 percent above listed rating.

The construction of the stadium presented several riser problems due to the fact that the most direct and logical routes were blocked by newly-constructed lounges, lockers and shower rooms. The risers for bull pens and towers C-1 and 2 were carried up columns 1 and 36 by breaking through the exterior corners of the concrete end ramps and an existing dumbwaiter shaft at column 30 was utilized to carry the risers to tower B-1. The remaining three risers were carried up columns 10, 14 and 25.

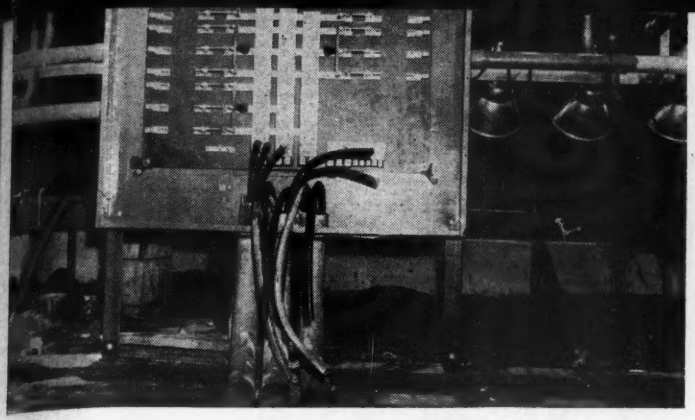
From each distribution panel the 3-phase system fans out through splice boxes to a series of 12-circuit lighting panels which in turn serve the individual lighting units. Three lighting panels containing a total of 36 circuits are operated from each master switch on the distribution panel. Floodlights were delivered with 4, 6 or 8-foot No. 12 leads wired to the socket through watertight snubbing glands in the housing and these leads were carried through hubs and stuffing glands into the lighting panels.

### Floodlighting Units

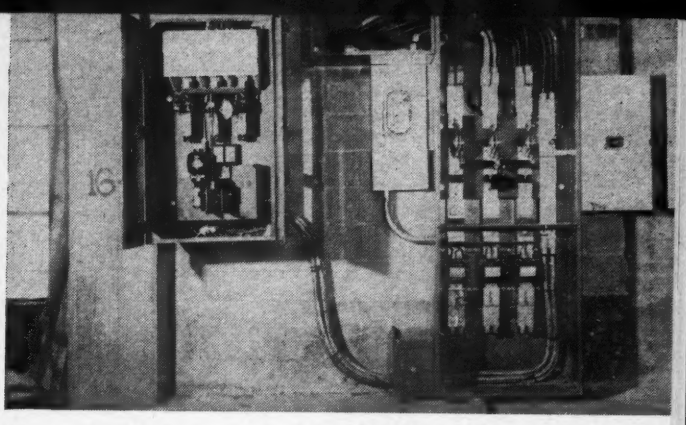
The floodlight units utilize the clear, general service 1500-watt lamp universally used for sports lighting and railroad yard illumination. Following the tested and accepted practice of burning the lamps at approximately 10 percent above their rated voltage, the system operates at 117 volts. Over-voltage operation results in a whiter light and increases the lumen output 38 percent with a corresponding increase of 16 percent in the power consumption and a 70 percent decrease in lamp life. Although this material reduction in life brings the working hours of the lamp down to 300, the resultant span is ample when realizing that the 14 night games scheduled for the Yankees this season should result in not more than 40 or 50 hours of lamp use. Assuming that football games, boxing bouts and pageants double this figure, the lamp replacement factor would remain relatively small. The utility charge for each night's consumption exceeds $500.

The reflector assembly, G. E. Type L-69, is a 19-pound corrosion-proof assembly of simple design with mechanical features that provide safe, accurate and rapid adjustment.

A corrugated steel mounting yoke is bolted to one of the horizontal angle-irons of the tower framework and may



*Four wire 3 phase system passes from main risers through distribution panels to lighting-panel feeders. Each main distribution switch controls three lighting panels serving a total of 36 floodlight circuits.*



*Typical secondary service installation consists of a combination pressure service switch and current transformer cabinet, metering facilities and a remote controlled circuit breaker.*

be swivelled horizontally through an azimuth of 180 degrees. This yoke, through two calibrated and adjustable trunnions, supports a die-cast aluminum collar holding the main reflector. A built-in clamping bolt-wrench on one of the trunnions instantly releases or clamps the bracket ring which may be rotated vertically through an arc of 135 degrees. A removable socket housing with an integral auxiliary specular reflector is held in contact with this bracket ring by two toggle latches so placed that improper positioning of the housing is impossible. A sealed joint between the housing and main reflector is assured through the employment of a woven asbestos gasket. The main reflector, asymmetrical in design, is spun into the die-cast collar and likewise is spun over the rim of 3/16-inch Tufflex tempered plate glass which seals the lighting unit. The glass thus becomes an integral part of the reflector and the entire assembly is weather, dirt and insect-proofed. The glass front, being resistant to impact and heat, eliminates the danger of broken glass falling on spectators seated directly below the towers.

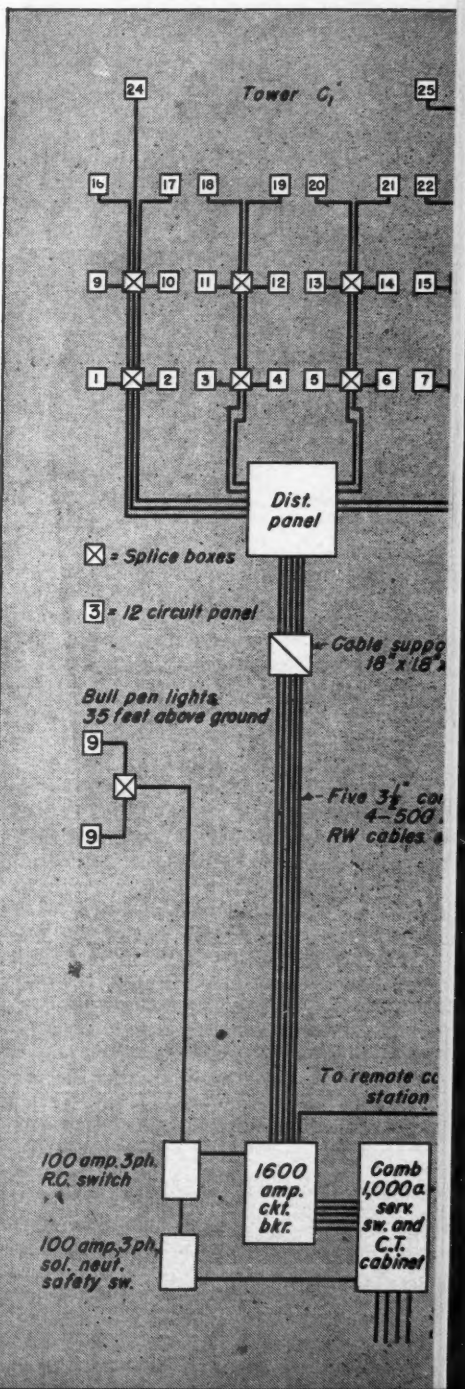
To insure accurate beam direction by the target method, a notched sight is located on the socket housing and a blade sight on the upper forward edge of the main reflector. The visual line passing through this twin sight guide coincides with the axis of the radiating light cone. Adjusting beams by the pre-determined geometric-plan method is possible by loosening the yoke and trunnion bolts, adjusting the graduated azimuth and declination scales to conform with the lighting plan, and re-tightening the bolts. At the Stadium, the pre-figured geometric plan was followed for initial settings with the left or right horizontal angles and declination of each unit listed on an aiming chart. As floodlights were mounted, the lights were focused in accordance with these settings. So successful was this procedure that final adjustment under actual operating conditions required only a few hours to blend the overlapping areas of light into an even level throughout the park. Former installations, requiring that lights be focused entirely in darkness, necessitated lengthy, expensive and hazardous overtime periods on the part of the erection crew.

When reflector servicing or lamp replacement becomes necessary, the housing may be quickly removed by springing the holding toggle latches. A stainless steel clip on the housing permits the maintenance man to temporarily attach the socket unit to the yoke, leaving both hands free for more efficient maintenance. Cleaning of the reflector is from the inside, the worker reaching in through the housing collar. In the event that an exploded lamp has deposited broken glass inside the assembly, the trunnion bolt may be loosened, the reflector turned upwards to allow the glass to drop out, the reflector returned to its marked position and the bolt retightened.

Although former installations have concentrated increased illumination on the action area of the infield, the Yankee plan results in equal distribution from batting box to the most distant point of the outfield and a light level of 200 footcandles likewise is maintained in the bull pens. Due to this uniformity of light, a pitching substitution does not inconvenience or endanger the relieving player through delayed retina adjustment, the flight of the ball is more plainly visible as it streaks from the bat to the outfield, and players immediately stepping up to the plate after coming from their positions in the field are not blinded momentarily by the visual im-

[Continued On Page 155]

*Secondary service installation supplies current to roof-based distribution panel through series of 500 MCM RW cables. Network of splice boxes and lighting panels serve banks of floodlights.*



# What is the MARKUP ?

## Part IV

**The size and Material-Labor ratio of an electrical construction project influence overhead costs. Adjustment factors to correct major overhead errors and obtain equitable percentages are analyzed in this final article of this series.**

**By Ray Ashley**
*Research and Consulting Engineer*
*Chicago, Illinois*

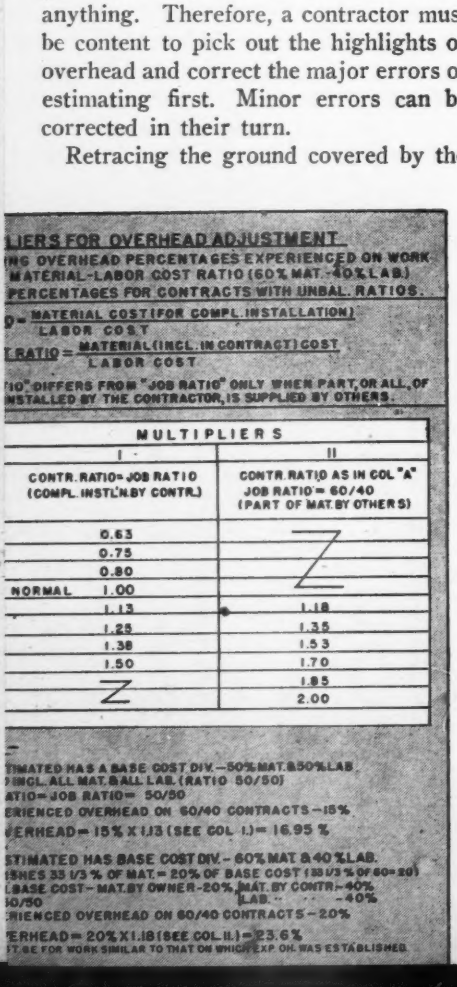
STUDIES of operating costs for electrical work can become very much involved. At the beginning, one who attempts to cover all details may get so confused that he is not sure of anything. Therefore, a contractor must be content to pick out the highlights of overhead and correct the major errors of estimating first. Minor errors can be corrected in their turn.

Retracing the ground covered by the three previous articles, we find that the contractor, who wishes to correct his errors in estimating overhead, has four significant items of business to consider.

1. Fictitious overhead must be eliminated and true overhead costs established for a basis of estimating.
2. Direct job costs should be charged as such and not included as overhead.
3. It costs more to supply labor than it does to supply material; therefore, separate markup should be used for each.
4. Overhead, in general, decreases as the size of the job increases.

Keeping such facts in mind will enable the contractor to focus his attention on the common influences which determine overhead costs.

Items 1 and 2 of the above listing were discussed at length in Part I of this series (E. C. April, 1946, pg. 74). Item 3 was covered in Part II (E. C. May, 1946, pg. 74) and Part III (E. C. June, 1946, pg. 70). However, to refresh the reader's memory, some figures regarding the relative cost of supplying material and labor will bear repetition.



LIERS FOR OVERHEAD ADJUSTMENT
NG OVERHEAD PERCENTAGES EXPERIENCED ON WORK
MATERIAL-LABOR COST RATIO (60% MAT.-40% LAB.)
PERCENTAGES FOR CONTRACTS WITH UNBAL. RATIOS.

D = MATERIAL COST (FOR COMPL. INSTALLATION) / LABOR COST
T RATIO = MATERIAL (INCL. IN CONTRACT) COST / LABOR COST

IO" DIFFERS FROM "JOB RATIO" ONLY WHEN PART, OR ALL, OF INSTALLED BY THE CONTRACTOR, IS SUPPLIED BY OTHERS.

| MULTIPLIERS | |
|---|---|
| I<br>CONTR. RATIO = JOB RATIO (COMPL. INST'L'N BY CONTR.) | II<br>CONTR. RATIO AS IN COL "A" JOB RATIO = 60/40 (PART OF MAT. BY OTHERS) |
| 0.63 | |
| 0.75 | |
| 0.80 | |
| NORMAL 1.00 | |
| 1.13 | 1.18 |
| 1.25 | 1.35 |
| 1.38 | 1.53 |
| 1.50 | 1.70 |
| | 1.85 |
| | 2.00 |

TIMATED HAS A BASE COST DIV.—50% MAT. & 50% LAB.
INCL. ALL MAT. & ALL LAB. (RATIO 50/50)
ATIO = JOB RATIO = 50/50
ERIENCED OVERHEAD ON 60/40 CONTRACTS—15%
VERHEAD = 15% X 1.13 (SEE COL. I.) = 16.95 %

STIMATED HAS BASE COST DIV.—60% MAT. & 40% LAB.
ISHES 33 1/3 % OF MAT. = 20% OF BASE COST (33 1/3 % OF 60 = 20)
(BASE COST—MAT. BY OWNER—20%, MAT. BY CONTR.—40%
60/50 LAB. —40%
RIENCED OVERHEAD ON 60/40 CONTRACTS—20%
ERHEAD = 20% X 1.18 (SEE COL. II.) = 23.6%
T BE FOR WORK SIMILAR TO THAT ON WHICH EXP. OH. WAS ESTABLISHED.

***FIG. 1—Multipliers for adjusting normal experienced overhead on projects where the Material-Labor ratio varies from the usual "60-40."***

Exhibit "B", Figure 1 of Part III ($500,000 volume) indicated that for a "60–40" (60 percent material and 40 percent labor—base cost) business, the overhead for material would be equal to approximately 50 percent of the experienced (the job) overhead, and that the overhead for labor would be equal to approximately 175 percent of the experienced overhead. Therefore the approximate overheads for material and labor could be established by use of the experienced overhead, as follows:

**Let X = the experienced overhead**

**Material overhead** $= \frac{50}{100} \times = 0.5 \times$

**Labor overhead** $= \frac{175}{100} \times = 1.75 \times$

**The approximate division for a 22 percent experienced overhead would then be:**

**Material overhead 0.5 × 22 = 11 percent**

**Labor overhead 1.75 × 22 = 38.5 percent**

**For a check figure, let us apply these percentages to a $10,000 ($6,000 material and $4,000 labor) job.**

| | | |
|---|---|---|
| **Markups** | **(Material $6,000 × 0.11 =** | **$660** |
| | **(Labor $4,000 × 0.385 =** | **$1,540** |
| | **Total** | **$2,200** |

**$2,200 = 22 percent of $10,000**

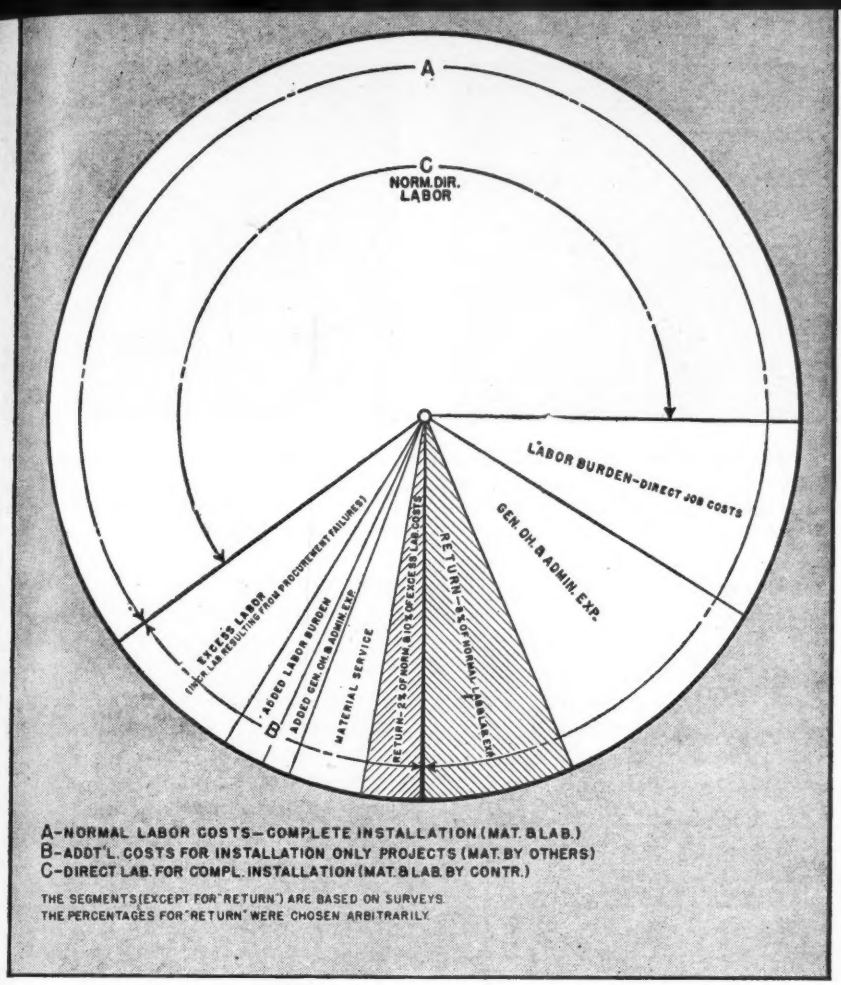

A
C
NORM. DIR. LABOR
LABOR BURDEN—DIRECT JOB COSTS
GEN. OH. & ADMIN. EXP.
RETURN—5% OF NORM. LABOR & EXP.
RETURN—5% OF NORMAL LABOR & EXP.
MATERIAL SERVICE
ADDED GEN. OH. & ADMIN. EXP.
ADDED LABOR BURDEN
EXCESS LABOR (OVER L&B RESULTING FROM PROCUREMENT FAILURES)
B
A—NORMAL LABOR COSTS—COMPLETE INSTALLATION (MAT. & LAB.)
B—ADDT'L. COSTS FOR INSTALLATION ONLY PROJECTS (MAT. BY OTHERS)
C—DIRECT LAB. FOR COMPL. INSTALLATION (MAT. & LAB. BY CONTR.)
THE SEGMENTS (EXCEPT FOR "RETURN") ARE BASED ON SURVEYS
THE PERCENTAGES FOR "RETURN" WERE CHOSEN ARBITRARILY

***FIG. 3—For "Installation-Only projects, the distribution of the electrical construction dollar is approximately as shown above.***

(2) *The percentages are general and serve only to show the trend of overhead costs.*

It is safe to bet that there are some contractors who will use their experienced volume overhead for small jobs and then use the curves as a gage for the larger projects. In such cases there will be no markup to compensate for small contracts.

The reader may ask, "What can be done to correct such foolish practices?" The answer: Nothing. We always have had and always will have contractors who shut their eyes to the things they do not want to believe. They do not care to admit that the percentages shown on "Overhead-Volume" curves for the $100 and $500 jobs are reasonable, but are anxious to accept the overhead percentages shown for the $100,000 projects.

Any reader not too familiar with electrical contracting, may ask another question—"How do such contractors stay in business?". The answer to that question, in most cases, is "Friends." These contractors have friends who feed them remunerative business—the returns from which keep them in business so they can bid wildly on other work.

Heretofore tables and figures have been largely confined to contracts for work having a base cost of 60 percent for material and 40 percent for labor. Local and national surveys indicate that, for the most part, electrical contracting business adheres quite closely to this divis-

The fourth "Significant Factor," like the first three, warrants careful analysis. Adjustment for this item ("Size of Job") has not been discussed to any extent because the previous article "Analyzing Overhead Costs" by A. C. McWilliams (E. C., Jan. 1946, pg. 61) illustrated the effects of job size on overhead. Figure 2 of this current article (Part IV) is a repetition of one of the curves shown in the January issue. The contractor who is not sure how his costs vary with job size, may use such curves as a check gage.

In connection with adjustments of overhead according to job size, the reader's attention is called to a very dangerous practice in electrical contracting: *the frequent attempts of contractors to compete for large jobs which they are in no position to handle properly.* A contractor may not have the organization, tools, nor experience, yet he will try to compete with the better organized institutions. In doing so he penalizes his own returns and the industry.

Anyone attempting to use the "volume overhead" curves for overhead adjustments should, in addition to remembering the foregoing articles on job costs, constantly remind himself of two things.

(1) *The percentages shown apply only for contractors who are equipped and organized to properly expedite contracts of the volume indicated.*

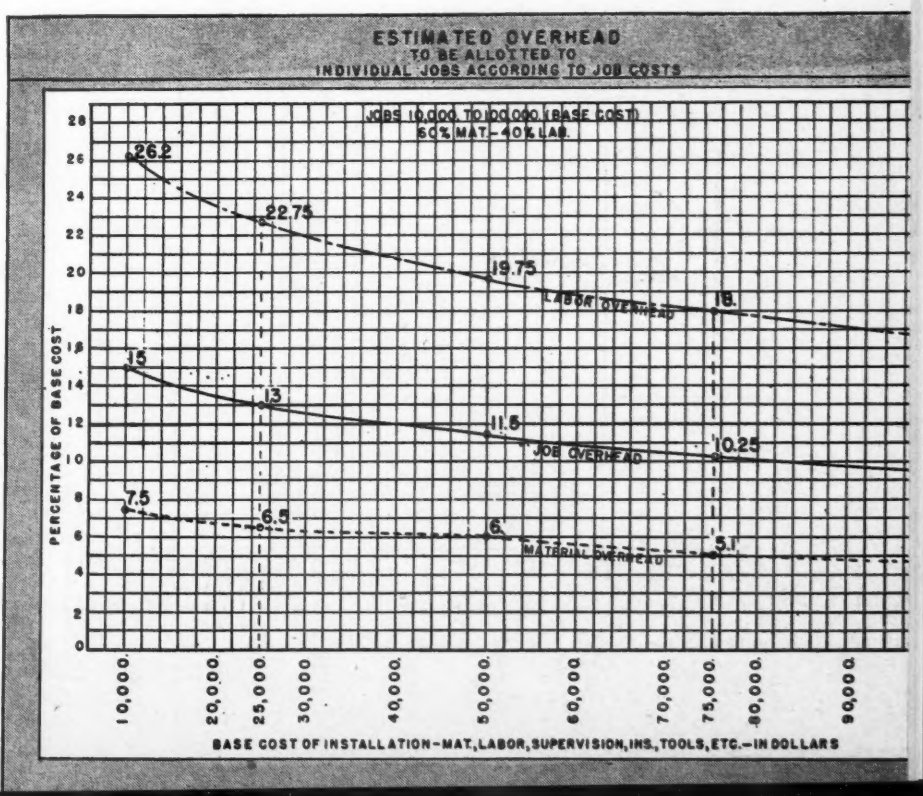



***FIG. 2—Estimated overhead for material, labor and the job varies with total base cost of the project. Chart shows percentages to be alloted to "60-40" jobs with base costs ranging from $10,000 to $100,000.***

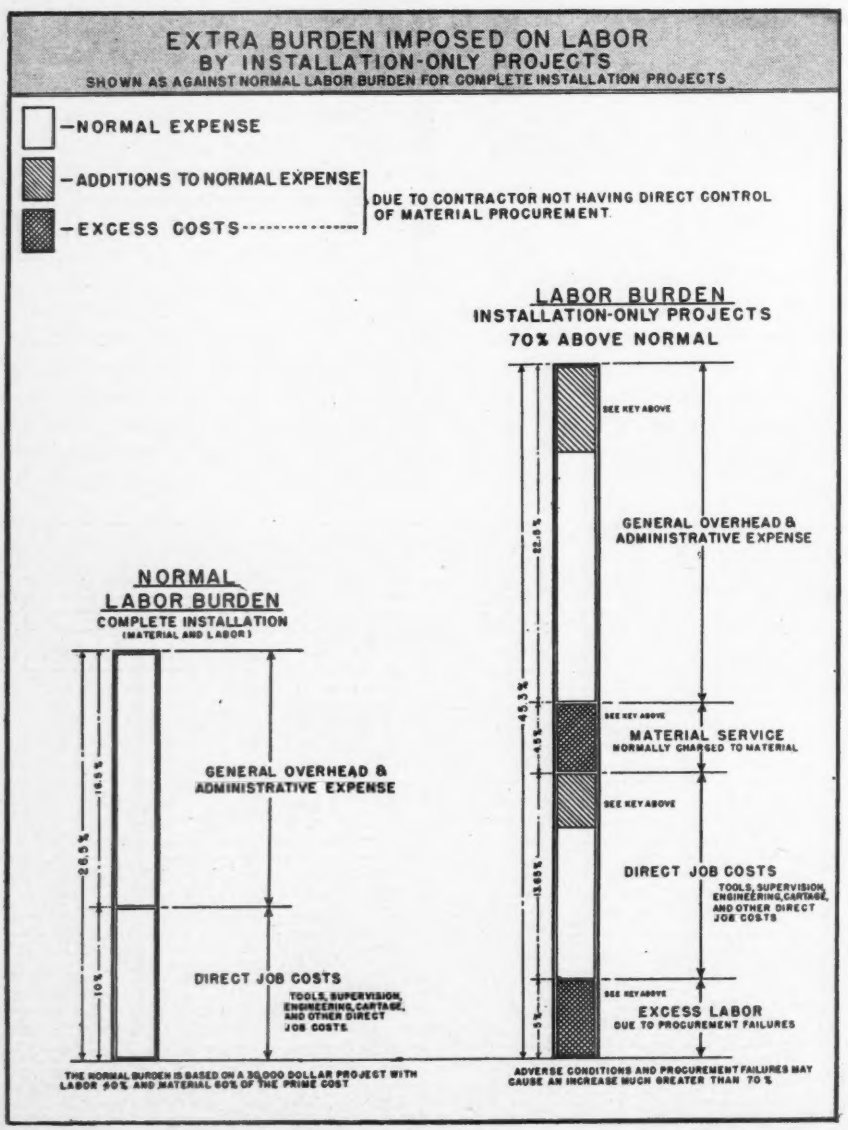
ion. *Therefore, the majority of contractors have an experienced overhead established on a "60–40" ratio. Any deviation from this ratio is reflected in overhead costs.*

Contractors are in the habit of classifying work into two distinct categories: Complete-Installations and Installation-Only projects. Their classification stops there. As shown by Figure 1, both of these classifications have several subdivisions. Each sub-division has to be given its individual consideration. To avoid lengthy discussion on the effects of variation in "M-L" (Material-Labor) ratios and Installation-Only projects, the tables shown in Figure 1 were prepared. For reasons previously explained, the base units are for "60–40" jobs.

Attention should be directed to the fact that the multipliers shown in Figure 1 are for adjusting overhead only. They are in no way designed to compensate for any increase in direct job costs. *For any Installation-Only work, a separate allowance has to be made for increased labor resulting from procurement failures, or other increased costs due to the potential hazards of such projects.* The reader should also bear in mind that, at best, such multipliers can serve to establish only an approximate adjustment of percentages. Along with changes in job and contract ratios there may be many other job factors which influence overhead.

A study of some of the figures will show how imperative it is that Material-Labor ratios be considered in both Complete-Installation and Installation-Only projects.

***FIG. 4—Comparative charts illustrating the extra burden that "Installation-Only" projects impose on labor. Shaded areas indicate added costs.***


EXTRA BURDEN IMPOSED ON LABOR
BY INSTALLATION-ONLY PROJECTS
SHOWN AS AGAINST NORMAL LABOR BURDEN FOR COMPLETE INSTALLATION PROJECTS
—NORMAL EXPENSE
—ADDITIONS TO NORMAL EXPENSE
—EXCESS COSTS
DUE TO CONTRACTOR NOT HAVING DIRECT CONTROL OF MATERIAL PROCUREMENT
LABOR BURDEN
INSTALLATION-ONLY PROJECTS
70% ABOVE NORMAL
NORMAL LABOR BURDEN
COMPLETE INSTALLATION
(MATERIAL AND LABOR)
GENERAL OVERHEAD & ADMINISTRATIVE EXPENSE
DIRECT JOB COSTS
TOOLS, SUPERVISION, ENGINEERING, CARTAGE, AND OTHER DIRECT JOB COSTS
SEE KEY ABOVE
GENERAL OVERHEAD & ADMINISTRATIVE EXPENSE
MATERIAL SERVICE
NORMALLY CHARGED TO MATERIAL
DIRECT JOB COSTS
TOOLS, SUPERVISION, ENGINEERING, CARTAGE, AND OTHER DIRECT JOB COSTS
EXCESS LABOR
DUE TO PROCUREMENT FAILURES
THE NORMAL BURDEN IS BASED ON A 30,000 DOLLAR PROJECT WITH LABOR 50% AND MATERIAL 50% OF THE PRIME COST
ADVERSE CONDITIONS AND PROCUREMENT FAILURES MAY CAUSE AN INCREASE MUCH GREATER THAN 70 %

INSTALLATION ONLY PROJECTS
MATERIAL BY OWNER
LABOR BY CONTRACTOR
WHO SUPPLIES THE FOLLOWING?
1 - SUPT. TO SELECT MECHANICS & ORG. CREW
2 - JOB TOOLS - CONSUMED & DEPR.
3 - MECHANICS' HAND TOOLS
4 - CARTAGE FOR TOOLS & CONST. EQUIPMENT
5 - FIELD SUPERVISION
6 - CONST. ENGINEERING SERVICE
7 - CONST. DRAWINGS
8 - STORAGE FACILITIES FOR MATERIALS
9 - INSURANCES - LAB.
10 - INSPECTION
11 - GUARANTEE ON THE WORK PERFORMED
12 - TESTING
13 - FINANCING OF THE LABOR
14 - GEN. OFFICE SERVICE - TEL., BOOKKPG., BILLING, ETC.
15 - ADMINISTRATIVE MANAGEMENT FOR COORDINATING ALL OF THE VARIOUS FUNCTIONS

***FIG. 5—The above items—all supplied by the contractor—must be considered when estimating "Installation-Only projects.***

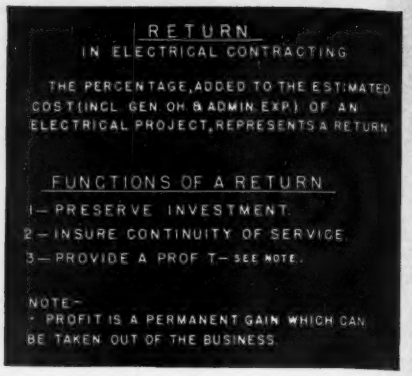

RETURN
IN ELECTRICAL CONTRACTING
THE PERCENTAGE, ADDED TO THE ESTIMATED COST (INCL. GEN. OH & ADMIN. EXP.) OF AN ELECTRICAL PROJECT, REPRESENTS A RETURN
FUNCTIONS OF A RETURN
1 — PRESERVE INVESTMENT
2 — INSURE CONTINUITY OF SERVICE
3 — PROVIDE A PROF T — SEE NOTE.
NOTE —
* PROFIT IS A PERMANENT GAIN WHICH CAN BE TAKEN OUT OF THE BUSINESS.

***FIG. 6—Definition and function of a "return" in an electrical contracting enterprise regardless of its size or its component breakdown.***

### Complete Installations

Column 1 (Figure 1) shows how overhead may be expected to vary with the "M-L" ratio. A contract for a "90-10" Complete Installation may have an overhead cost of approximately 63 percent of that for a "60-40" job of similar volume and type. Again, another job with a "20-80" ratio may be expected to have an overhead which is 150 percent of normal (normal being a "60-40" ratio).

In the first instance the overhead is 37 percent (100-63) below normal; in the second it is 50 percent above normal —a spread of 87 percent. A contractor who has a normal overhead of 20 percent would have approximately 12.6 percent for the "90-10" contract and 30 percent for the "20-80" job.

To obtain these results without using the multipliers, the procedure would be as follows:

For a 20 percent Job Overhead (Normal "60–40" ratio), the separate markups would be—

(0.5 x 20)* = 10% material, approximate,

(1.75 x 20)* = 35% labor, approximate,

* Note statement about Exhibit "B", Figure 1, Part III of this series.

[Continued On Page 58]

# VISUAL EDUCATION SELLS SERVICE

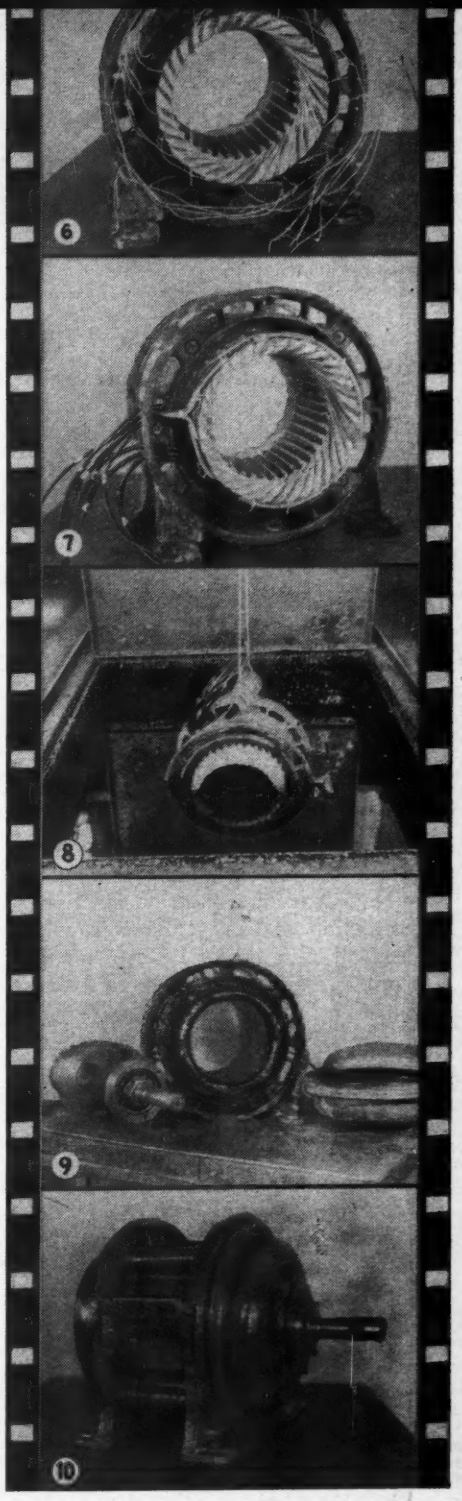
**Photographs attract attention, establish contacts, promote confidence, educate customers and justify time and charges incident to performing electrical work**

IT is generally conceded that visual education is an asset in crystallizing ideas and promoting thought. This theory has proven valuable in schools, the military and naval services, varied organizations, trade groups and private organizations. Many people will pause to glance at pictures when they are presumably too busy or too preoccupied to comprehendingly listen or understand instructors, engineers or contractors. Normal curiosity promotes attention to a series of photographs and, when these pictures tell a vivid, cryptic story, any explanatory remarks are heard by a more receptive audience.

The H. N. Crowder Jr. Company of Allentown and Easton, brings this approach into the electrical field. Series of story-telling photographs are mounted in an attractive album which is available to all salesmen and engineers who contact either regular or prospective customers. The pictures show progressive steps followed in typical jobs, the personnel of the organization, the shop and field equipment as well as jobs of outstanding interest or importance which the company has completed. The pictures not only establish a mental contact but also serve to interest and educate the customer. Since it is impractical to take every customer through the shops, the shops are taken to the customer through the lens of a camera.

Another pictorial benefit is the explanation or justification of time consumed or charges rendered for service or repair work. Many customers, without appreciating the complexity of electrical work, are often surprised at the time and expense involved when a contractor complies with the simple request to, "Wind it." After visualizing the steps required, the workmanship and sound procedures followed, complaints frequently become compliments.

A typical example of this visual educational approach can be indicated by




glancing at the accompanying illustrating photographs which are part of a Crowder series showing the rewinding of a 5 hp., 440 volt, 60 cycle, 3 phase, G. E. motor from its receipt at the plant to its final assembly and painting prior to customer re-delivery.

Similar series of photographs tell the installation story of wiring jobs, lighting, d-c a-c changeovers, high-voltage stories and power installations. The size and capabilities of the organization are presented favorably and the small cost involved in photographic and lighting equipment is multiply justified.

# Rewinding and Reconnecting

**A continuation of the discussion of rewinding and reconnecting induction motors. A description of the frequency change in a two phase motor.**

LAST month we discussed the changing from three phase to single phase. Here we continue with changing from three phase to two phase.

*Three-phase to two-phase change.*—A reconnection from three-phase series star to two-phase is not advisable as there are not enough coils for placing in series in the two-phase connection. This reconnection would amount to operating the motor at 25 percent overvoltage and would probably burn out the motor even at no load.

In case a group of motors operating from a local two-phase power plant are to be fed from a nearby three-phase distribution system permanently or in times of local power failure, the best solution is perhaps the use of a Scott-connected transformer of suitable rating and voltage. Two-phase power may thus be made available from the three-phase line resulting in flexibility of operation without reconnecting or rewinding the two-phase motors.

It is often required in practice to change the operating voltage of a motor to meet local conditions. Two-voltage motors have the necessary leads brought out for making this change externally. In all types of voltage change, there are two important points to remember. First, to check whether the insulation of the winding is safe on the voltage to be used, and second, to see that a turn, coil, or coil group is not subjected to a higher voltage than it was before the change. The simple expedient of series and parallel connections may be utilized to good advantage. Voltage variations of 10 percent and frequency variations of 5 percent above or below the original values are permissible. It must be pointed out that voltage and frequency should never be varied simultaneously in opposite directions and, with decreased frequency, operation at less than normal voltage would result in higher current and temperature.

In making a voltage change while frequency, number of phases, horsepower output, and speed remain the same, the following expression may be used:

$$T_2 = T_1 \times E_2/E_1$$

where T and E are the number of turns and voltage and subscripts 1 and 2 denote values before and after the change. When the motor is rewound for the new voltage, the coil pitch must remain the same.

The operating characteristics of the motor are affected to various extents with the change of voltage from its original value. Overvoltage results in a rise in maximum overload capacity, starting current, starting and running torque, magnetic losses, and to a lesser extent, a rise in efficiency and full load speed. On the other hand, overvoltage causes reduced full load current, lower operating temperature, slip, and power-factor. Undervoltage has the inverse effects.

*Example.*—A three-phase, 2-pole, 440 volt, series-star connected motor is to be reconnected for operation on three-phase, 220 volt supply.

Each phase-winding originally designed for 440 volt / 1.73 = 254 volts is divided in half or to two coil groups each good for 254 volts / 2 = 127 volts. The two halves of each phase are connected in parallel in such a way that the instantaneous direction of current flow in the two parallel paths is the same as it was in the series connection. This method of connection is shown in Fig. 5. The three groups are then connected in star. The resulting winding is good for 127 volts x 1.73 = 220 volts.

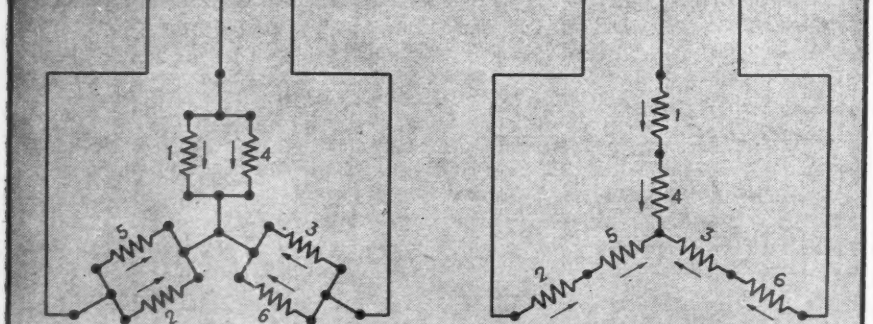



***Fig. 5.—(a) A 2-pole, 440 volt, series-star connected three-phase motor. (b) Stator of Fig. 5a reconnected for operation on a 220 volt, three-phase supply.***

### Changing Rated Frequency and Speed

In most cases, the change in the rated frequency of a motor is made in such a manner as to keep the speed and horsepower approximately the same on the new frequency as they were on the old. The change may be made by rewinding the motor with entirely new coils while changing the number of poles in the inverse ratio of the frequency change to the nearest even number of poles on the new frequency. For instance, in a 25 cycle to 60 cycle change, the number of poles on the 25 cycle winding is increased in the ratio of approximately 60/25 to the nearest even number of poles on 60 cycles.

In making a frequency change on a motor which is to operate a drive at a predetermined speed, the following step-by-step method may be used:

1) *New horsepower rating.*—The new horsepower rating of the motor

# A-C Motors PART III

By
**Rouel G. Cazanjian**
*Electrical Engineer*
*Brooklyn, N. Y.*

varies almost directly as the speed and is affected somewhat by the slip. In a fan or a centrifugal pump drive, the input varies as the cube of the speed. For instance, if the speed is raised 10 percent, the input to the drive must be $(1.10)^3$ or 33 percent higher. Therefore, care must be taken not to overload the motor when the new number of poles at the new frequency makes the motor run at a higher speed. The other alternative would be to operate the motor at the next lower speed which may impair the effectiveness of the fan or centrifugal pump.

An average value of slip at normal frequency is about 4 percent. At a lower speed than normal with unmodified rotor, the slip may be expected to be about 6 percent due to increased current paths between fewer adjacent poles in the end-rings. For nearly normal operation, in a 60 to 25 cycle change, the cross section of the rotor end rings should be increased in the ratio of 60/25. In a 25 to 60 cycle change, the cross-section of each end ring should be reduced in the ratio of 25/60 or 41.7 percent by suitably taking a cut off on a lathe in order to keep the starting and full load currents within satisfactory limits. If the rotor is of the wound type, and the stator is rewound, corresponding changes must be made in the rotor. In a 25 to 60 cycle change with unmodified rotor and approximately the same speed, the somewhat reduced slip may in most cases be neglected.

The new horsepower rating with unmodified rotor may be expressed as follows:

For the next lower synchronous speed at the new frequency,

$$Hp._2 = Hp._1 \times (N_2/N_1) \times (0.94/0.96)$$

For the next higher synchronous speed and the new frequency,

$$Hp._2 = Hp._1 \times (N_2/N_1)$$

where $N$ is the synchronous speed at the specified frequency and subscripts 1 and 2 denote constants before and after the change.

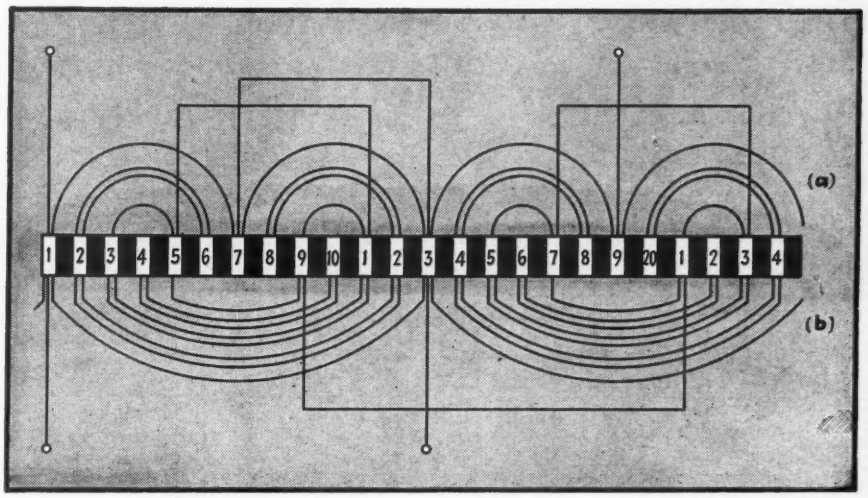



***Fig. 6.—A 0.25 hp., 1725 rpm., 120 volt, 60 cycle single-phase blower motor with 24 stator slots, squirrel cage rotor, split-phase winding not shown. (b) Stator core of Fig. 6a rewound with a two-pole winding to operate on 120 volt, 25 cycles. Starting winding not shown.***

2) *Checking flux density in stator core.*—When the frequency is decreased such as in a 60 to 25 cycle change, the flux per pole is increased in direct proportion to the number of poles on 60 cycles as compared with that on 25 cycles, if the total amount of flux is to remain unchanged. Whether or not this increase in flux density is permissible for a given stator core depends entirely on how liberally it was originally designed. The keeping of approximately the same speed and horsepower is limited therefore by the permissible increase in the stator core flux density. Evidently, in a 25 to 60 cycle change, this limitation does not exist.

3) *Calculation of distribution factor.*—Assuming a 25 to 60 cycle change, it is necessary to use the same percentage of coil pitch and general winding distribution in the 60 cycle winding as was used in the 25 cycle winding. As the number of slots is fixed, this is not always possible or even practicable. Any change in the winding arrangement necessitates the application of chord factor and distribution factor in order to compensate for the change in the effectiveness of the coils. As before, for three-phase, the distribution factor may be taken as 0.955 and the chord factor is figured out as described under phase change. In single-phase, the distribution factor only is determined as the effect of the chord factor is combined with it.

4) *Calculation of the stator winding.*—Assuming the change to be made at the same number of phases and voltage, and considering the change in frequency $f$, number of poles $p$, chord factor $K$, and distribution factor $D$, with subscripts 1 and 2 denoting constants before and after the change, the number of turns in series in the stator will be:

$$T_2 = T_1 \times f_1/f_2 \times p_2/p_1 \times K_1/K_2 \times D_1/D_2$$

5) *Calculation of magnet wire size.*—The size of magnet wire on the new winding will be:

$$Q_2 = Q_1 \times T_1/T_2$$

where $Q$ is the cross section of magnet wire in circular mils.

6) *Other changes.*—In a 25 to 60 cycle change, the cross section of the rotor end rings happens to be 60/25 larger than on a corresponding 25 cycle motor of normal design. This condition affects torque, efficiency, and slip. Unless corrected, this lower secondary resistance allows the rotor to operate somewhat cooler but causes the primary to take higher starting and running currents.

In a 60 to 25 cycle change, the cross section of the end rings should be increased in the ratio of 60/25 if torque, efficiency, and slip are to be kept constant. With the exception of lower operating torque and efficiency and slightly higher slip, the motor will operate satisfactorily.

[Continued on page 156]

# NEW LIGHT

By
**C. B. Stiles and G. C. Knapp**
*Application Laboratory,*
*Sylvania Electric Products, Inc.*

**Long slim fluorescent lamps are well suited for lighting floor and wall cases in nearly two million stores.**

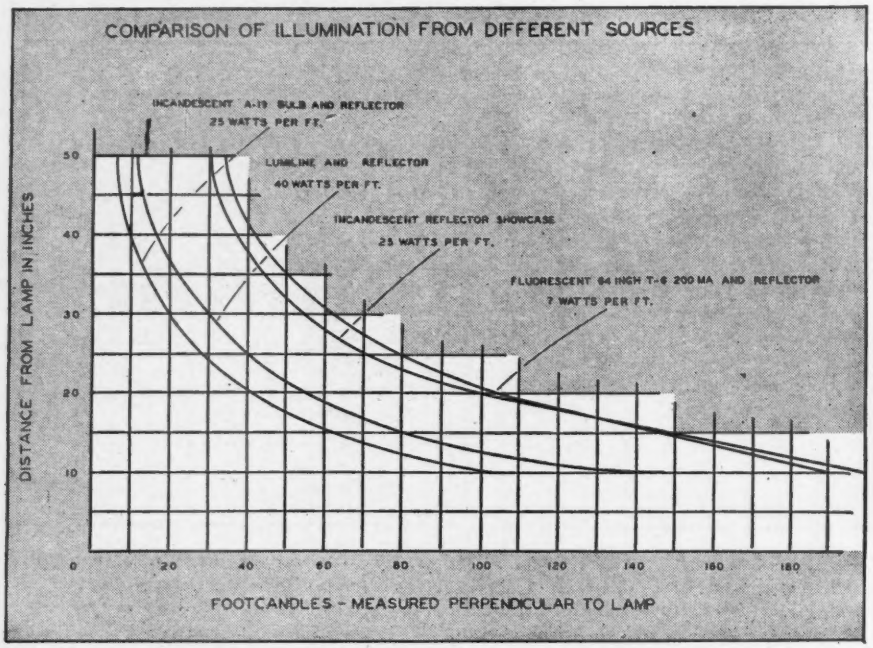



***FIG. 1—Graph illustrates the high efficiency of long slim fluorescent lamps, which provide better illumination at one third the current consumption.***

THERE are 1,770,000 retail establishments in the United States! That figure taken from a recent Sylvania Electric commercial lighting survey indicates the vast possibilities for the electrical contractor who realizes the potentialities of this lighting market.

The contractor has a big selling job to do on proper lighting for wall and showcases in these retail outlets. The display lighting in many of these units has long gone unheeded. Yet today, it is more important to proper merchandising than ever before. Merchandising methods, not shortages, are going to make the public buy, and well-lighted displays are the focal point of intelligent sales efforts.

The technique of proper case lighting has been greatly advanced by the development of the long slim fluorescent lamp, designed in several sizes specifically to fit average cases and to deliver sufficient quantities of efficient "selling light". These lamps, manufactured in four different lengths, are of small diameter (¾-inch for the 42-inch and 64-inch lengths and 1-inch for the 72-inch and 96-inch lengths), making them particularly adaptable to cases where the lamp and reflector must be as inconspicuous as possible. In addition, they are instant starting and require no starters, thereby lessening the amount of maintenance and initial wiring.

Long slim fluorescent lamps require secondary voltages, ranging from 450 volt for the 42-inch lamp to 750 volt for the 96-inch lamp, which are higher than those usually used in display lighting. Safety features are incorporated in the lampholders which break the primary circuit when the lamp is removed. Lampholders approved by the Underwriters up to 1000 volts, an adequate safety margin, are built specifically to house the long slim lamps which have a simple and strong single pin contact. These lampholders are available for both the T-6 and T-8 lamps, although the T-8 will accept either type of lamp. The most popular size is the T-6 since it is more compact and the majority of showcases are not over six feet in length. The usual ballast for the long slims is designed for 200 ma. operation but where a lower level of resultant illumination is acceptable, ballasts for 100 ma. operation may be used.

Light from a long slim is ideally suited to case illumination because it is cool and efficient. Like any other

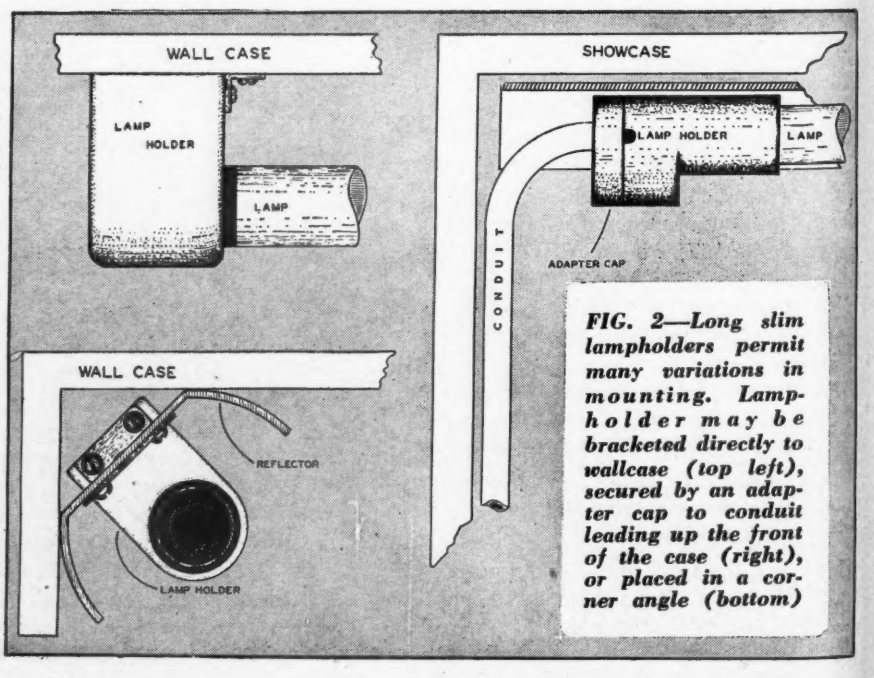



***FIG. 2—Long slim lampholders permit many variations in mounting. Lampholder may be bracketed directly to wallcase (top left), secured by an adapter cap to conduit leading up the front of the case (right), or placed in a corner angle (bottom)***

# FOR DISPLAY CASES

*FIG. 3—The contrast between incandescent and long slim fluorescent lighting for showcases is evidenced in this counter at the David Low Jewelry and Notion store, Salem, Massachusetts. Spotty, incomplete lighting in the case at left is from incandescent lamps in ordinary showcase reflectors. The 64 inch T-6 long slim fluorescent lamp casts even and virtually glarefree light throughout the case on the right.*

fluorescent lamp, the long slim emanates light from a linear, low brightness source and eliminates the unpleasant hot spots on counter tops caused by incandescent display lighting. Only two such spots occur, in cases illuminated by long slim fluorescents and these are at the corners of the showcase, never in the center. Figures in Table 1 for long slim temperatures are maximum ones since they were obtained without using reflectors which would normally distribute the heat.

From Fig. 1 it can be seen how efficient long slim lamps are in comparison to incandescent types for case lighting. Long slims deliver a maximum amount of footcandles for a minimum amount of power, and the light itself is of a white quality which makes goods appear fresh and attractive.

The contractor will like working with long slims because their installation in

**TABLE I**

**TEMPERATURE OF WARMEST SPOTS ON CASE TOPS RESULTING FROM LAMPS UNDERNEATH GLASS OF QUARTER INCH THICKNESS—NO REFLECTOR**

| Position of glass case top in relation to lamp while taking temp. readings. | 36" T8 30 watts | 72" T8 cold cath. 120 MA | 64" T6 long slim 100 MA | 64" T6 long slim 200 MA | 21" T5 showcase |
|---|---|---|---|---|---|
| At end of lamp above Electrode (lamp in contact with glass) | 114° | 124° | 89° | 114° | 103° |
| At end of lamp above electrode (with ½" space between lamp and glass) | 103° | 106° | 79° | 93° | 89° |
| In middle of lamp (with ½" space between lamp and glass) | 90° | 79° | 79° | 88° | 83° |

Temperatures in degrees Fahrenheit. Room temperature—75° F.

***FIG. 4—Shown above are two types of plastic long slim lampholders for T-6 lamps.***

cases is a simple task. Usually, it will require only one lamp for each showcase or span in a wall case, and the lampholder can be concealed in the corner of the case or behind some center support. By the addition of reflectors which hug the bulb contour, the entire installation can be made quite inconspicuous.

How to convince a merchant of the need for improved lighting in wall and showcases is a problem faced by those who recognize the value of long slim lamps for this purpose. The following questions should serve as a guide in awakening the merchant's interest in his showcase lighting.

Is the lighting in the cases uniform?

Are the lamps and reflectors inconspicuous?

Are there annoying heat spots on the showcase tops?

Is the proportionate level of light such that it attracts the eye from a distance? (The top inside shelf should be about four times the general store illumination at the outside of the counter top or an average of 100 footcandles in small stores.)

Are goods deep in the showcase well illuminated or are they lost in dimness?

Is the color of light satisfactory?

Is the heat of the light likely to harm the display?

If these questions do not elicit satisfactory answers, then the showcase lighting needs remedying with long slim lamps. The same questions may be used in selling better lighting for wallcases.

Two points which may be brought up in the discussion of fluorescent lamps for display work are the fading of colors and the true reproduction of colors under fluorescent light. Fluorescent lamps do *not* accelerate the fading of dyes any more than other types of light sources. Some dyes do fade more quickly than desirable, but this is because the particular dye is "fleeting" or improperly fixed. In such cases, fading occurs just as readily with incandescent bulbs or sunlight, although there may be an occasional difference between any one color and any two light sources. In general, fading is a direct result of the total time the merchandise is exposed to light and of the actual intensity of the illumination, regardless of source. With reasonable attention to display turnover and to the type of material or dye, fading should be no problem since the increase in display effectiveness will outweigh these considerations.

Similarly, fluorescent lamps are excellent when it is desired to reproduce true colors. Although fluorescent, like any general light source, is not perfect, it actually enhances more displays than it distorts. Merchants are accustomed to yellowish incandescent lamps, but they don't realize that incandescent distorts dark greens and blues while fluorescent light accentuates these colors most. Reds are slightly weaker under fluorescent lamps, but not to such a degree where it is a handicap to general case lighting, except where color matching is essential. In such cases special incandescent equipment is required, not general lighting. One factor, however, which will adversely affect any artificial illumination, is the quality of showcase glass, especially that which has a greenish cast. Light of any form will appear distorted here.

With these considerations settled, it is possible to consider specific lighting requirements for the average showcase. This store fixture is approximately six feet long at floor level and is several inches shorter inside the case at the top front edge. The long slim, which was designed for this showcase, is the 64-inch T-6 lamp. With its ballast placed beneath the case and the wires brought up through a pipe in a front corner, this lamp will provide a neat, practical installation which will give satisfactory footcandle levels for almost every type of display.

The 42-inch T-6 lamp may be similarly installed, but the 72-inch T-8 and 96-inch T-8 require a different type of mounting since no lampholders to make use of small pipe connections have been announced for these models. These lampholders may be mounted by bracketing directly to the reflector or by butting against some barrier at the ends of the case. (Fig. 2).

The chief use of 72-inch and 96-inch lamps, however, will probably be in the larger and more varied wallcases where small size lamps and reflectors are not as essential. Here, these long lamps will work to advantage being excellent attention-getting light sources. The combination of 42-inch and 64-inch lamps is probably the most advisable in extra long showcases.

**TABLE II**

| Lamp | Opr. current | Opr. watts | Lumens |
|---|---|---|---|
| 42" | 100 MA | 15 | 900 |
| | 200 MA | 25 | 1400 |
| 64" | 100 MA | 23 | 1400 |
| | 200 MA | 38 | 2150 |
| 72" | 100 MA | 22 | 1400 |
| | 200 MA | 38 | 2350 |
| 96" | 100 MA | 30 | 1950 |
| | 200 MA | 52 | 3300 |

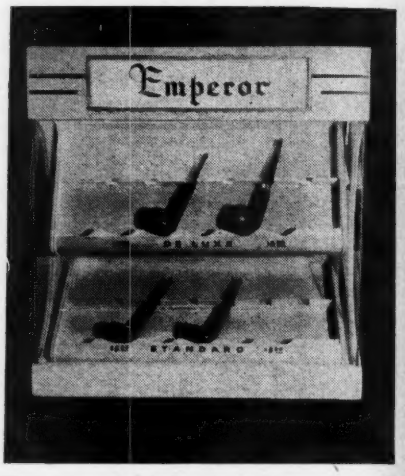
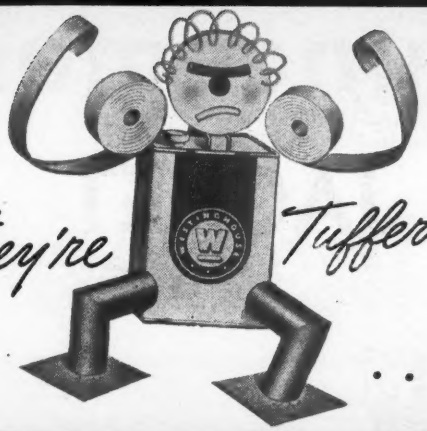



***FIG. 5—Specially built counter displays are given added interest with fluorescent lighting. Above display is illuminated by standard 12-inch 8 watt miniature fluorescent lamp.***

Although long slims provide excellent general case lighting, some of the smaller bi-pin fluorescent lamps which have ordinary sockets, starters and ballasts can be used effectively for special displays on counter tops. Two of these, the 21-inch 13-watt T-5 and the 12-inch 8-watt T-5, are short in length and narrow in diameter and readily fit into out of the way corners to add extra interest to the display.

These are just a few of the ways fluorescent lighting can be employed to advantage in show and wallcases. There are many more, but the enterprising contractor will think of others and sell the merchant on the need for relighting now. This job has been made easier by the addition of "long slims" to the fluorescent line. With such a natural sales media, the contractor is missing a good opportunity if he fails to exploit it.

Then, too, this might lead to something bigger. For it is going to call his attention to the outdated general store illumination, and there is a strong likelihood that the contractor will be called upon to do the complete modernization job.



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# Practical Methods

## BASEBALL SCOREBOARD INNOVATION

WIRING

Sports fans attempting to accurately score baseball games are often in doubt whether a hit or an error should be recorded in cases where a hard hit ball into the infield is momentarily juggled and the runner beats the throw to first base. Spectators attending night games in New York's Yankee Stadium appreciate an illuminated scoreboard indicator which immediately registers the official decision on these plays.

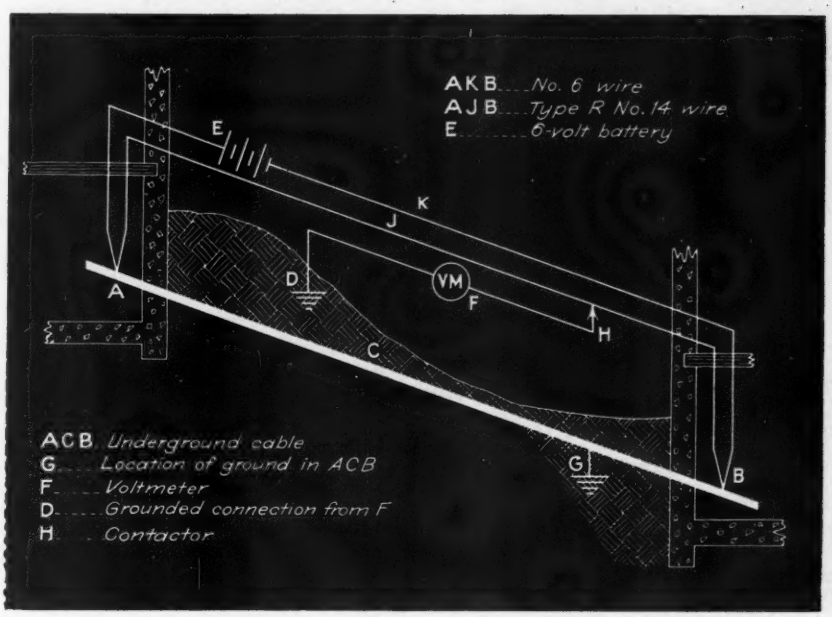
Behind two 6½-inch amber bulls-eyes on the scoreboard, plainly marked "hit" and "error", are two 150-watt lamps and reflectors. The flashing of either light is controlled by a special double throw switch so designed that only one of the two lights can be lit at one time. An audio speaker, connecting the press box with the scoreboard, advises the scoreboard operator of the official ruling on the play and the proper indicating bulls-eye is flashed for the information of those in the stands. Although this indicating system is simple in theory and design, it is believed that the Yankee board is the only one in the country with this feature.

General illumination of the scoreboard is from 16 - 750-watt floodlights mounted at the foot and six feet in front of the board. The floodlighting units are shielded from the players on the field and the spectators in the grandstands by a built up trough extending the width of the board.

## LOCATING GROUNDS IN BURIED CABLES

WIRING

A practical method for locating underground "grounds" has been extensively used and is recommended by R. E. S. Swam, electrical engineer of Hanover, Pennsylvania. The method is simple and accurate, saving both time and the expense of trenching to uncover a long stretch of buried cable to determine the exact location of the trouble.




***A 6-volt storage battery (E) is connected to either end of the buried cable at points A and B by means of a No. 6 conductor. A No. 14 wire is likewise attached to the same terminals and stretched in parallel with the buried cable. The contactor (H) of a grounded voltmeter (F) is moved along the No. 14 wire until the meter reads zero. The ground of the buried cable (G) will be located directly below the point of the contactor.***

Along the surface of the ground, parallel to the path of the buried cable being tested, a No. 14, type R insulated wire is run, connected at either end to the underground cable. Also stretching between these two terminals is a No. 6 conductor which links a 6-volt storage battery to the hook-up. One connection of a low reading d-c voltmeter is grounded with a length of wire sufficiently long to permit the movement of the meter from one end of the underground cable to the other. The other side of the voltmeter is connected to a contacting device by which the copper wire inside the type R insulated cable can be touched. The contacting device may be either a sharp knife blade or needle-like probe for piercing the covering.

When actually checking for grounds in the buried conductor, the contacting device is moved along the No. 14 wire until the voltmeter reads zero. If the No. 14 wire has accurately parallelled the path of the underground wire, the ground fault will lie directly below the point of the contactor.

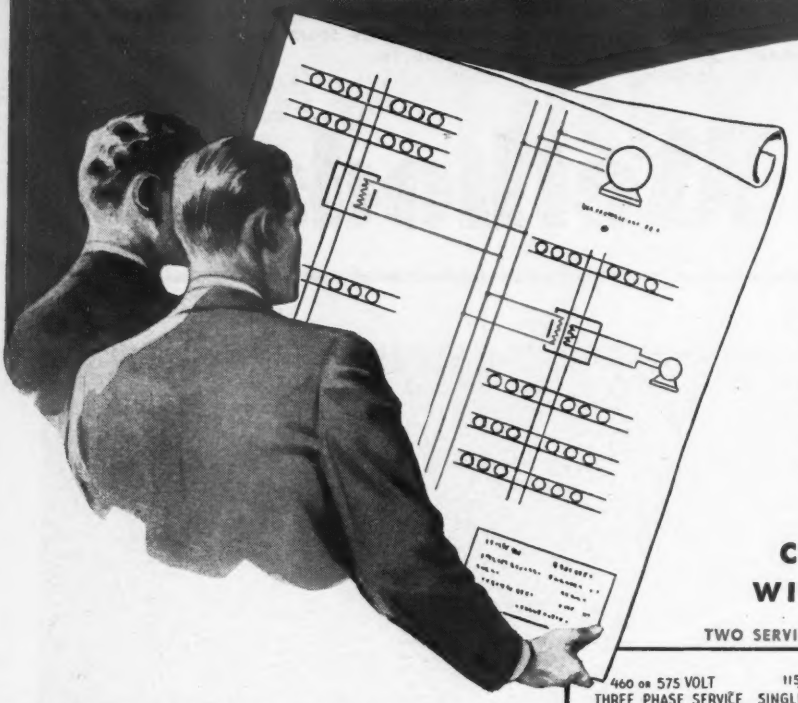
If the No. 14 wire can be insulated from the ground, a bare wire can be used which will make it easy to move the contactor along the wire.

## CRIMPING DEVICE IS SAFE, EXACT, RAPID

INDUSTRIAL

Considerable attention has been devoted to improving the safety, accuracy and speed of hand crimping sheet metal at the Glenn L. Martin Company, Baltimore. Crimping formerly required a tool resembling an oversized pair of pliers which required considerable effort to pull around the edge of the metal. Having no stationary guide, satisfactory crimps were not always obtained, and the element of danger was present since

# CUT PLANT WIRING COSTS



When it comes time to re-wire your existing building or if there is a new plant on the drafting boards, it will pay in definite economies to consider Jefferson Power Circuit Transformers. The use of this type transformer, in providing for low voltage circuits, eliminates the wiring system which would otherwise be required for 115 volt devices. Thus, only the higher-voltage, lower-cost circuit (230, 460 or 575V) needs to be installed, resulting in valuable savings of copper, conduit, fittings, labor, and power costs.

Since Jefferson Power Circuit Transformers are the dry type, they can be mounted at convenient locations throughout the plant—on wall, post, or directly on the machine to provide the 115 volt current required for lamps, fans, control push buttons, electric heating and small, motor-driven equipment. No special vaults are required, each transformer being self-contained and air cooled. Each unit is also equipped with a roomy wiring compartment with knockouts for rigid or flexible conduit connections.

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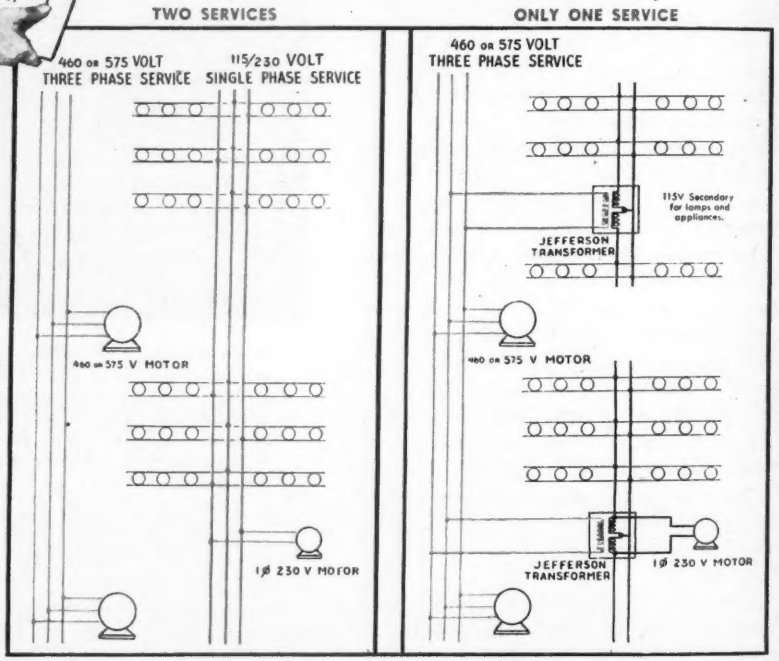
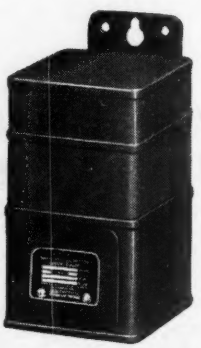
## COMPARE THESE TWO WIRING INSTALLATIONS


TWO SERVICES
ONLY ONE SERVICE
460 or 575 VOLT THREE PHASE SERVICE
115/230 VOLT SINGLE PHASE SERVICE
460 or 575 V MOTOR
1ø 230 V MOTOR
460 or 575 VOLT THREE PHASE SERVICE
115V Secondary for lamps and appliances.
JEFFERSON TRANSFORMER
460 or 575 V MOTOR
JEFFERSON TRANSFORMER
1ø 230 V MOTOR

**LEFT:** This diagram shows two service entrances—one 460 volts and the other 115 volts—requiring two entirely separate wiring systems. **RIGHT:** The same requirements are met by the more economical wiring plan through the use of Jefferson Power Circuit Transformers. Current is purchased at 460 volts and there is only one service entrance.

JEFFERSON ELECTRIC



***Power Circuit Dry Type***

# TRANSFORMERS

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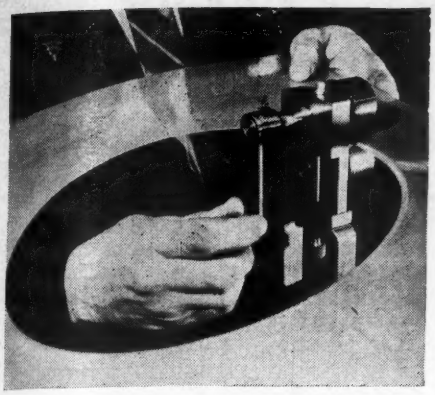


***Mechanical crimper takes metal up to 16-gauge in thickness. Operation is similar to wall-fastened can opener. Operator is protected against cuts while using device.***

the tool sometimes slipped while under pressure, resulting in cuts to the hands and arms of the operator.

A device for crimping sheet metal up to 16-gauge thickness, at the bench, the job or after installation was recently designed by Frank Lucarelli, one of Martin's tool designers, and it has been proved in use that the tool works equally well on straight edged metal or sheets curved to any shape. It also can be used on the inside of blanked-out holes where crimping of metal is required.

In general shape, it is not unlike the familiar kitchen wall-fastened can opener or a shoemaker's tool for crimping pieces of leather together. Two round dies, one with a projecting edge, the other rounded to fit, are held together by spring tension and an adjusting screw fits them for various thicknesses of metal. Turning a crank pulls the metal sheet between the dies. Held firmly against a guide, the edge of the metal is crimped to the desired shape. Little physical strength is required for the operation and the time saved is half that of other hand tools performing the same job. The tool is operated by clamping it in a vise. By substituting a wheel for the conventional handle it can be used on the job, crimping after the piece has been installed, or a new crimp can be put into a piece of sheet metal without having to completely remove it from its installed location.

## WIRING A LABORATORY

WIRING

Testing, experimentation, research and invention are constant factors in the steady advancement of science and industry. Contributing alike to chemistry, mechanics, construction, medicine and electronics are the engineers and scientists who are accurately checking, measuring, regulating, changing and improving both existing and new products, methods and applications. The great majority of reputable commercial concerns, industries, colleges, technical foundations and purchasing departments maintain laboratories where specified conditions are created, controlled and recorded. Few laboratories are operating in the absence of electricity and wiring such an installation for power and light requires rigid adherence to standards and appreciation of the importance of this phase of electrical contracting. Not only must the wiring layout be properly installed and protected but it must provide for accurately maintaining and recording circuit characteristics under changing laboratory demands. Depending on local requirements, wiring systems should be designed to withstand corrosive, abrasive or explosive conditions. An indication of the scope of laboratory wiring is evident from studying the accompanying check list.

### WIRING CHECK LIST FOR LABORATORIES

| | | |
|---|---|---|
| Air compressors | Fog Dispersion | Refrigerators |
| Alarms; fire, theft | Furnaces | Shelf heaters |
| Annealing furnaces | Grinders | Soldering irons |
| Bacteriological incubators | Heated sand baths | Sterilizers |
| Ball and tube mills | Heating equipment | Stirrers |
| Battery charging sets | Hot plates | Storage batteries |
| Chemical bath heaters | Hot water urns | Suction fans |
| Clocks | Humidifiers | Test tube heaters |
| Crushers | Incubator for germ research | Thermostats |
| Dehumidifying apparatus | Mixers | Trucks |
| Disc stoves | Ovens | Tools |
| Distilling apparatus | Pumps | Vacuum systems |
| Drinking fountains | Pyrometers | Water distilling apparatus |
| Fans, ventilation | Recording instruments | Water heaters |
| Flask heaters | Refrigeration | X-ray equipment |

| Illumination: | Recommended footcandles |
|---|---|
| Corridors, stock and washrooms | 5— 15 |
| Normal bench or desk work, filing | 15— 30 |
| Checking instruments | 30— 60 |
| Inspection of products or materials | 60—100 |
| Fine inspection or color work | 100—200 |

## PIPE FRAME BETWEEN I-BEAMS SUPPORTS LIGHTING FIXTURES

WIRING

The Andren-Myerson Corporation of Boston, Mass., recently equipped their motor repair shop with modern, planned lighting which was installed by J. J. Reddington, electrical contractor of the same city. Since each unit was located to most effectively illuminate a particular area or pre-located piece of machinery, a geometrically symmetrical layout was not adopted; and since overhead construction included I-beams, brick arches, wooden joists and planks, several methods of mounting had to be devised.

For mounting fixtures between I-beams, the pictured method was followed. Short lengths of ½-inch pipe were placed above and below the lower flange of the beams and rigidly clamped together by bolted pairs of half-round flanged conduit straps. The pipes or crossbars thus gripped the beam flanges and a sturdy mounting framework was formed. Outlet boxes were hung on the lower crossbar and the fluorescent fixtures suspended below these boxes. This method permitted a flexible lighting plan and will allow ready adjustment to any future changes in shop layout.

***Industrial fluorescent fixtures are suspended from outlet boxes mounted below pipe crossbars. Pipe framework is rigidly clamped to lower I-beam flanges by bolted conduit straps.***

SERVING YOU THROUGH SCIENCE

# NEW CODE CHANGES SHOW PROGRESS IN BRANCH CIRCUIT WIRING

| | | R | RH | RW | RU | T (Formerly SN) | TW |
|---|---|---|---|---|---|---|---|
| Maximum Operating Temperature | 1940 | 50 C | 75 C | 60 C | 60 C | 60 C | |
| | 1946 | 60 C | 75 C | 60 C | 60 C | 60 C | 60 C |
| Insulation Wall Thickness | 1940 | 3/64"—#14, 12, 10 AWG<br>4/64"—#8—2 AWG<br>5/64"—#1—4/0 AWG | 3/64"—#14, 12, 10 AWG<br>4/64"—#8—2 AWG<br>5/64"—#1—4/0 AWG | 3/64"—#14, 12, 10 AWG<br>4/64"—#8—2 AWG<br>5/64"—#1—4/0 AWG | 18 Mils (1.15/64)<br>#14, 12, 10 AWG | 2/64"—#14, 12, 10 AWG<br>3/64"—#8 AWG<br>4/64"—#6—2 AWG<br>5/64"—#1—4/0 AWG | |
| | 1946 | 2/64"—#14, 12 AWG<br>3/64"—#10 AWG<br>4/64"—#8—2 AWG<br>5/64"—#1—4/0 AWG | 2/64"—#14, 12 AWG<br>3/64"—#10 AWG<br>4/64"—#8—2 AWG<br>5/64"—#1—4/0 AWG | 3/64"—#14, 12, 10 AWG<br>4/64"—#8—2 AWG<br>5/64"—#1—4/0 AWG | 18 Mils (1.15/64)<br>#14, 12, 10 AWG<br>25 Mils (1.6/64)<br>#8, 6 AWG | 2/64"—#14, 12, 10 AWG<br>3/64"—#8 AWG<br>4/64"—#6—2 AWG<br>5/64"—#1—4/0 AWG | 2/64"—#14, 12, 10 AWG<br>3/64"—#8 AWG<br>4/64"—#6—2 AWG<br>5/64"—#1—4/0 AWG |
| Uses (Under National Electrical Code) | 1940 | General Use | General Use | General Use or in Wet Locations | Rewiring Only | Rewiring Only | |
| | 1946 | General Use | General Use | General Use or in Wet Locations | General Use<br>May be used in Non-Metallic Sheathed Cable | #14—4/0 AWG General<br>#14—2000 MCM Open Work | #14—4/0 AWG General<br>#14—2000 MCM Open Work |
| Sizes (Under National Electrical Code) | 1940 | #14—2000 MCM | #14—2000 MCM | #14—2000 MCM | #14, 12, 10 AWG | #14—4/0 AWG | |
| | 1946 | #14—2000 MCM | #14—2000 MCM | #14—2000 MCM | Now Approved in Sizes #14—6 AWG | #14—4/0 AWG General<br>#14—2000 MCM Open Work | #14—4/0 AWG General<br>#14—2000 MCM Open Work |

Current Carrying Capacity (In Amperes)

| | R | | | RH | | | RW | | | RU | | | T (Formerly SN) | | | TW | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size | Conduit* | Open Wiring | Size | Conduit* | Open Wiring | Size | Conduit* | Open Wiring | Size | Conduit* | Open Wiring | Size | Conduit* | Open Wiring | Size | Conduit* | Open Wiring |
| 1940 | 14 | 15 | 20 | 14 | 22 | 29 | 14 | 15 | | 14 | 18 | | 14 | 18 | | | | |
| | 12 | 20 | 26 | 12 | 27 | 37 | 12 | 20 | | 12 | 23 | | 12 | 23 | | | | |
| | 10 | 25 | 35 | 10 | 37 | 50 | 10 | 25 | | 10 | 31 | | 10 | 31 | | | | |
| | 8 | 35 | 48 | 8 | 49 | 69 | 8 | 35 | | | | | 8 | 41 | | | | |
| | 6 | 45 | 65 | 6 | 65 | 94 | 6 | 45 | | | | | 6 | 54 | | | | |
| | 4 | 60 | 87 | 4 | 86 | 125 | 4 | 60 | | | | | 4 | 72 | | | | |
| | 2 | 80 | 118 | 2 | 115 | 170 | 2 | 80 | | | | | 2 | 96 | | | | |
| 1946 | 14 | 15 | 20 | 14 | 15 | 20 | 14 | 15 | 20 | 14 | 15 | 20 | 14 | 15 | 20 | 14 | 15 | 20 |
| | 12 | 20 | 25 | 12 | 20 | 25 | 12 | 20 | 25 | 12 | 20 | 25 | 12 | 20 | 25 | 12 | 20 | 25 |
| | 10 | 30 | 40 | 10 | 30 | 40 | 10 | 30 | 40 | 10 | 30 | 40 | 10 | 30 | 40 | 10 | 30 | 40 |
| | 8 | 40 | 55 | 8 | 45 | 65 | 8 | 40 | 55 | 8 | 40 | 55 | 8 | 40 | 55 | 8 | 40 | 55 |
| | 6 | 55 | 80 | 6 | 65 | 95 | 6 | 55 | 80 | 6 | 55 | 80 | 6 | 55 | 80 | 6 | 55 | 80 |
| | 4 | 70 | 105 | 4 | 85 | 125 | 4 | 70 | 105 | | | | 4 | 70 | 105 | 4 | 70 | 105 |
| | 2 | 95 | 140 | 2 | 115 | 170 | 2 | 95 | 140 | | | | 2 | 95 | 140 | 2 | 95 | 140 |

*Not more than 3 conductors in conduit, raceway or cable. For more than three conductors in conduit, raceway or cable, reduce current carrying capacity in accordance with 1946 Code.

Write for new wall hanger soon available. In meantime, use this chart

**NOTE:** According to Underwriters Laboratories; 1946 Code—R, RH and RW—may be labeled after April 1, 1946. Manufacturers need not produce until November 1. When production does start, Underwriters' labels must be applied and tags must be marked: "1946 Code."

1940 Code—R, RH, RW—may be labeled until November 1, 1946. Stocks in inventory after November 1 may be used until supply is exhausted.

**Laytex (RU) is America's smallest diameter, lightest weight rubber insulated branch circuit wire. Laminated construction and perfectly centered conductors insure electrical safety.**

# UNITED STATES RUBBER COMPANY

1230 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

## DE-ICER FREES RAILWAY SWITCHES

INDUSTRIAL

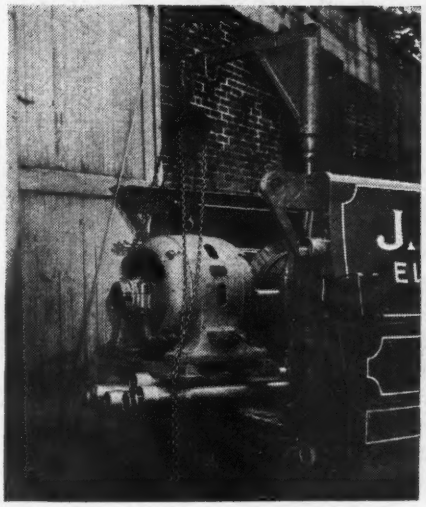
Many northern cities annually experience the inconvenience and delay caused by low temperatures freezing streetcar switching apparatus. Traffic becomes sluggish and snarled unless additional labor is employed to remove the ice formations from the switch tongue and motivating machinery.

The Cleveland Railway Company solved the problem by installing ground heaters parallel and in close proximity to the switches. The heating elements,

***Railway track de-icer consists of 600 volt element in length of wrought iron pipe which maintains temperature of surrounding ground above freezing point and insures winter-long uninterupted service from switches.***

operating at 600 volts, are incased in 8-foot 10-inch sections of wrought iron piping that radiate sufficient heat to prevent the freezing of the surrounding ground and neighboring switches.

The relatively small cost of the equipment and incremental current is considered insignificant when compared to the improved car service and the elimination of the special labor parties.



***Swinging boom on rear of line truck covers complete circular arc, making it possible for attached chain hoist to raise or lower heavy loads from ground or floor of truck body. A 40 hp. motor is pictured being swung from the truck to the loading apron where it will be lifted by a traveling crane on an overhead monorail and transported to the shop interior.***

## TRUCK BORNE BOOM LIFTS LOADS

CONSTRUCTION

Of great assistance to contractors performing line work, handling large capacity motors or transporting heavy cable reels is a small boom on the rear or side of their trucks, from which a chain hoist may be suspended.

J. J. Reddington Electric Service, of Roxbury, Mass., was fortunate in being able to secure a 2-ton Ford telephone line truck which has proven ideal as a work-horse and traveling shop. The value of the truck has been increased by mounting a swinging boom on the rear of the truck body and attaching a chain hoist to it. The swing of the boom covers an entire circle so that loads may be raised or lowered from the ground or floor of the truck body. The illustration pictures a 40 hp. motor being swung from the truck. A second truck operated by Reddington has the boom mounted just behind and to the right of the cab but this location has not proven as satisfactory as the rear mounting due to the necessity of removing a side panel each time a load is swung on or off the truck.

An overhead monorail in the Reddington shop extends through bi-parting loading doors and overhangs the loading ramp, making it possible to pick up and transport heavy loads from the line truck directly to the shop interior.

## ROLLING RACK FOR PANEL ASSEMBLING

CONSTRUCTION

Assembling electrical panelboards on a rolling rack keeps panels in an upright position and maintains sections in their planned relation to each other. The panels can be moved readily about the shop, allowing for necessary testing and the installation of equipment at locations most convenient for each operation. The mobile rack, designed and constructed in the shop of the Andren-Myerson Corporation of Boston, Mass., is erected on two 6-inch I-beams, 5 feet in length, supported at either end by rubber-roller swiveling industrial casters. From the midpoints of each of these I-beams, 7-foot lengths of 1½-inch pipe are erected and braced as illustrated to points on the beams just inside of the caster mountings. The two beams are cross-connected by an 8-foot section of pipe which, bolted to the centers of the beams, forms the crossbar of the base which resembles the letter H.

A similar pipe connects the upper extremities of the vertical mounting pipes but, unlike the rigid lower crossbar, can be raised or lowered at will by the use of adjustable U-bolt clamps. Intermediate vertical pipes, also U-bolted to the upper and lower crossbars, can be adjusted at varying distances from one another. The mounting framework for assembling any electrical panel thus can be adjusted both for height and width and as many as four panels can be assembled on the same rolling rack. Since the beams, casters, pipes and U-bolts were salvaged from scrap material, the assembly represents a small investment which renders a large return in efficient panel assembly.

***Rolling mounting rack, made from scrap materials, is adjustable for height and width, holds four electrical panels during stages of assembly and is readily moved about the shop to the most convenient locations for testing and installing equipment.***

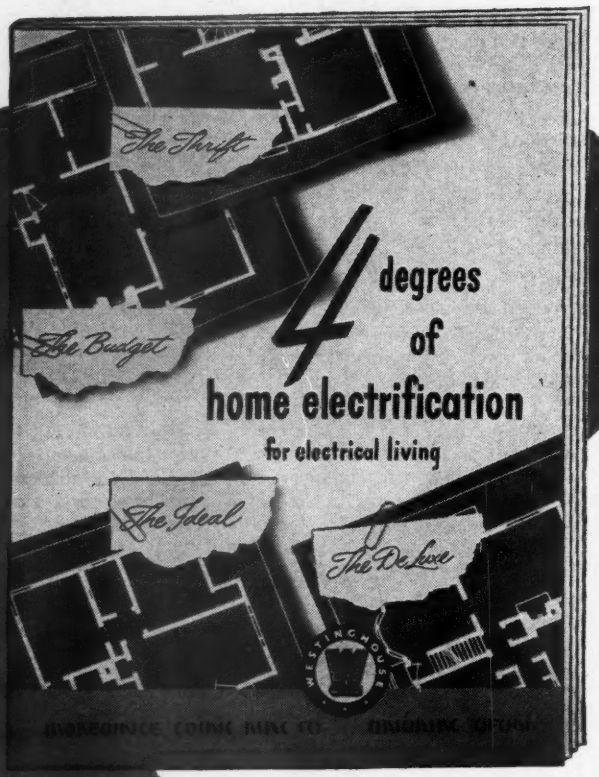
There's a degree of *Electrical Living* for every home

# A New Development In Electrical Systems For Homes

How much wiring is needed to bring Electrical Living to families of various income levels? Westinghouse gives you the answer with the Four Degrees of Home Electrification.

Starting with a minimum, each degree adds new equipment and special features. A homeowner can easily decide which of the four degrees will meet his Electrical Living requirements. It is then a simple matter for you to show him from the diagram the engineered wiring required.

This new way of selling correct wiring for homes helps you raise the standard of home electrical systems, and improves your opportunities for profits. The booklet illustrated above clearly describes this new development. Send for booklet B-3774 . . . it's Free. J-91558-B




. . . and this handbook has the technical data needed for designing any residential installation

The most comprehensive handbook ever produced on home wiring. Ten chapters, 120 pages. Dozens of charts, tables and diagrams. Covers every detail you require to plan and design a complete electrical system for homes. Costs one dollar. Send coupon below.

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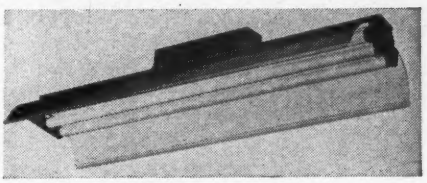
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

BETTER HOMES DEPARTMENT

**THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.**

# Equipment News

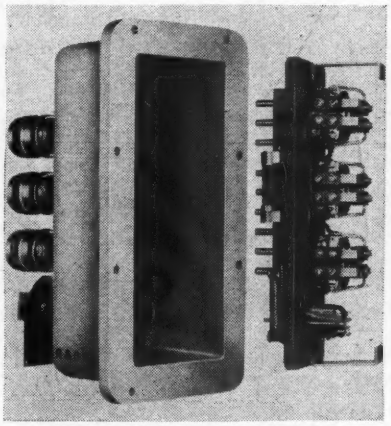
## Fluorescent Fixtures



HOLDENLINE FIXTURE

Three new fluorescent fixtures have been announced. The P-24 is a 24-in. single lamp fixture, CSS-80, a 2-lamp 40 watt unit and CSS-120, a 3 lamp 40 watt fixture. The P-24 was designed for localized lighting. It has exposed ballasts for cooler operation. The reflectors and the positive socket spacing are reported as so designed that flexible lighting is assured. It is also available in 48-in. lengths and is adaptable for factory or home use. The CSS-80 has a polymerized synthetic finish on the reflectors. Ballasts are exposed. The butt-on sockets are protected by sheet steel. The CSS-120 has open ballasts, ample wire freeway, and photometrically designed reflectors. Sockets are welded to the end plates. Holdenline Inc., 1960 E. 57th St., Cleveland 3, Ohio.

## Unit Alarm System



RUSSELL AND STOLL UNILARM

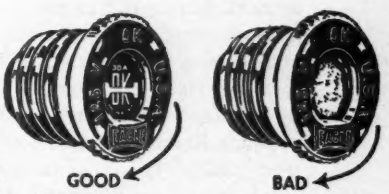
A unit alarm system for the supervision of equipment and processes is marketed under the name of "Unilarm" and provides in a single enclosure many features essential for complete supervision. The system is primarily designed to indicate departures from predetermined temperatures, levels and pressure ranges and operates through lights of different colors which give visible signals and a howler alarm which attracts the attention of supervisors not in the immediate vicinity. All contact making devices are assembled on a plug-in panel and replacement units may be instantly inserted. As many units as required may be installed with a common howler or gong circuit without the possibility of feed backs occurring. The howler is silenced by the operator pressing an acknowledging button but a steady light continues to burn until the abnormal condition returns to normal. Russell and Stoll Co, Inc., 125 Barclay St., New York 7, N. Y.

## Frequency Meter

CML FREQUENCY METER

This new electronic A-F frequency unit is a device for measuring the frequency of a-c voltages over the entire audible frequency spectrum. In conjunction with a new "photo-beam converter", Model 1800 becomes an electronic tachometer for measuring the speed of rotating or reciprocal mechanisms, including those which cannot be subjected to any additional mechanical load. Speeds in excess of one million rpm. or cpm. can be measured with this instrument. It can also be used to measure relatively slow speeds in the order of 60 rpm. or cpm. by means of a special frequency-multiplying disc or similar device. Some of its applications are—to determine the unknown frequency of various a-c voltage sources; to check the calibration of heat-frequency oscillators or other audio-voltage generators; to measure the different frequency between a standard radio-frequency oscillator and a local or remote radio transmitter; to determine the difference frequency between a crystal oscillator and a standard-frequency generator. Communication Measurements Laboratory, 120 Greenwich St., New York 6. N. Y.

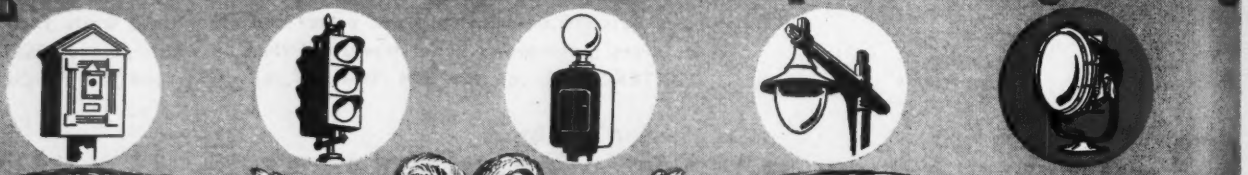
## Glass Fuse

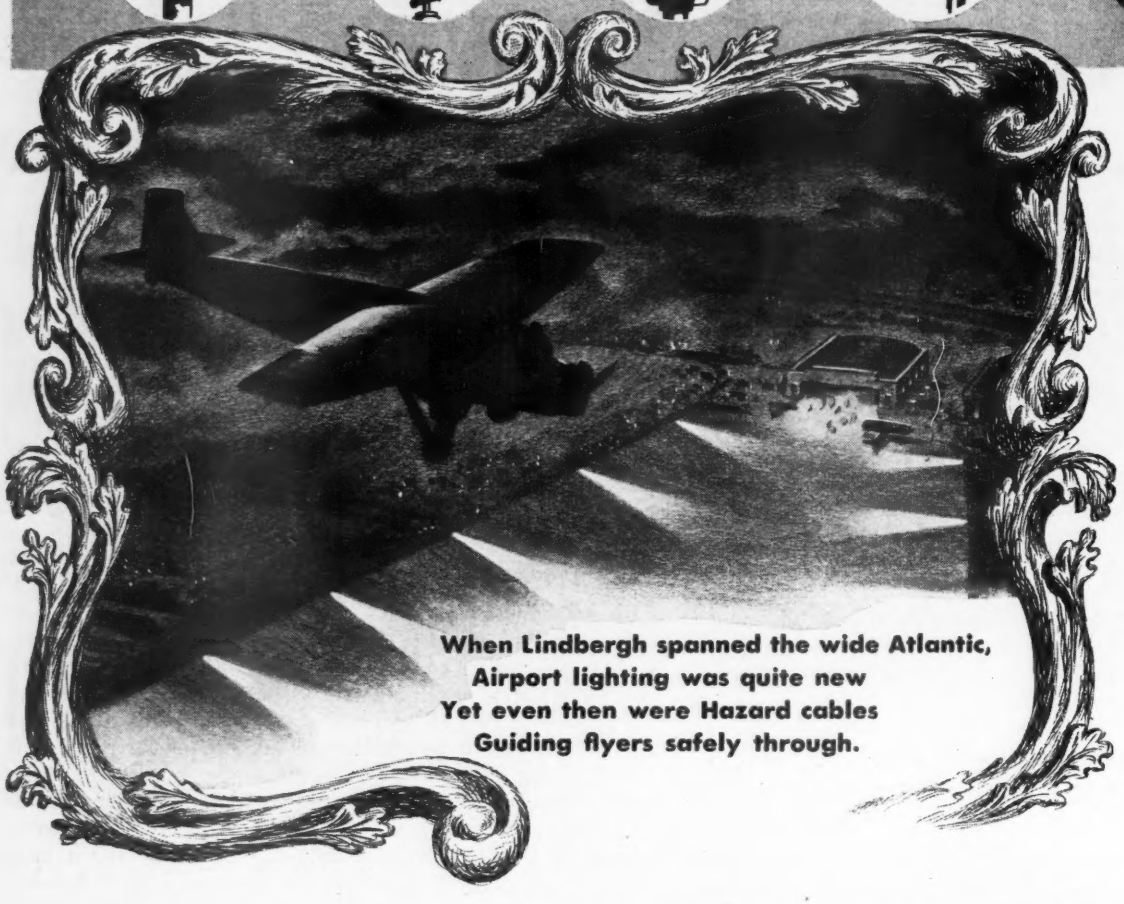



EAGLE GLASS FUSE

An improved fuse has been placed on the market which permits instant appraisal of the rated amperage and the operating condition of the fuse through distinguishing markings on the head. Fuses with capacities of 15 amps. or less have hexagonal centers while higher amperages are quickly identified by vari-colored discs. A magnifying center affords clear visibility of the fuse element. This element remains intact and with sharp outline up to the point of overload. Partial disintegration warns of such an overloaded condition and the "OK" trade-mark entirely vanishes when a dead short or blown fuse materializes. Standard sizes of 10, 15, 20, 25 and 30 amps. are packed 5 to a box, 100 to a carton and 500 to a standard 35 lb. package. Eagle Electric Mfg. Co. Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.

# Hazard cables for airport lighting



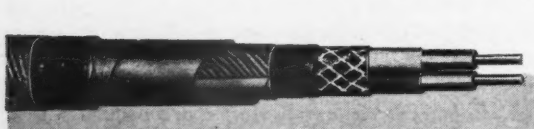


**When Lindbergh spanned the wide Atlantic,**
**Airport lighting was quite new**
**Yet even then were Hazard cables**
**Guiding flyers safely through.**

Airport lighting has come a long way since those days when a safe hop across the Atlantic was news. Hazard Armortite Cables carried the power for many of these pioneer airport lighting systems, and unaffected by the rigors of the past twenty years, some of these same cables are still carrying the load in their original installations.

With the scientific progress made in Hazard cable design, Armortite is a still better cable for airport lighting today. It's light in weight, easy to install, splice and tap. And you can select it with complete confidence because of its record for dependable, trouble-free service for years and years. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

**HAZARD ARMORTITE CABLE**...armored, moisture-proof, may be buried directly underground without conduit. The non-corrosive Hazard submarine insulation is protected by plastic sealing compound, asphalted jute, and non-metallic tape armor. This construction withstands temperature changes of 130 degrees, soil acids, alkalies, mechanical damage, etc. As no lead sheath or steel armor is required, Hazard Armortite is light-weight, easy to install and moderate in cost. Send for Bulletin 115.

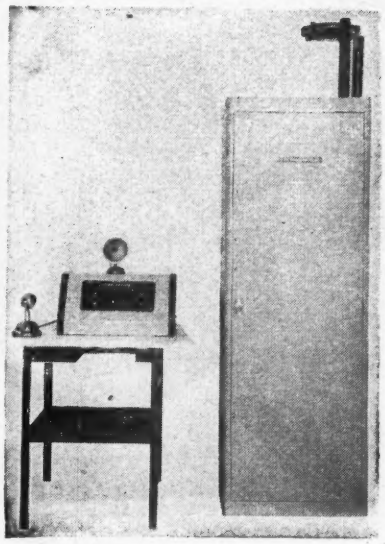


**HAZARD**

**insulated wires and cables for every electrical use**

4649

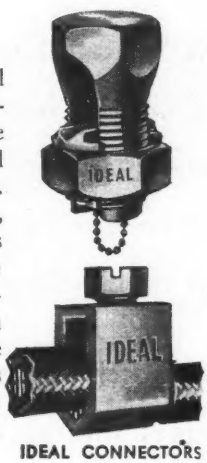
## FM Railroad Radio Equipment



WESTINGHOUSE RADIO EQUIPMENT

Railroad radio equipment designed to provide voice communication between the locomotive and the caboose, between trains on the same or adjacent tracks, between the train and wayside station, or between yard locomotives and the yardmaster's office has been announced. The equipment is composed of two basic assemblies: fixed station assemblies for installation in wayside stations and yards, and mobile assemblies for installation on the locomotive or caboose. Both operate on a standardized power supply of 117 volts a-c. Rotary converters are supplied with mobile units to provide the required a-c voltage from either a 32 or 64 volt d-c supply. Frequency modulated, the transmitter operates in the 152-162 megacycle band. The output frequency is obtained by use of frequency multipliers which follow a crystal controlled oscillator. A tone generator for calling purposes, and an automatic level control circuit to prevent excessive audio input and distortion are mounted on the transmitter chasses. Standard vacuum tubes are used throughout. Westinghouse Electric Corp., Pittsburgh 30, Pa.

## Connectors

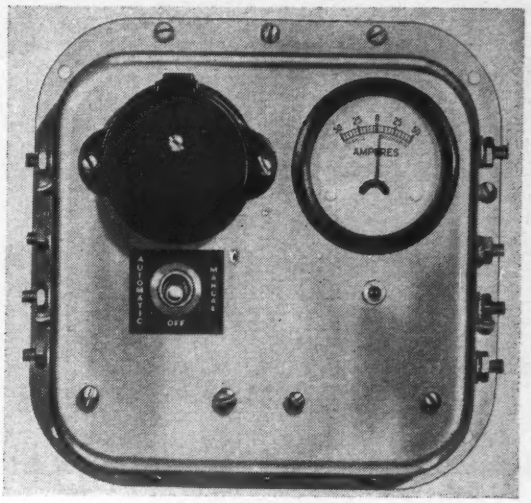



IDEAL CONNECTORS

A new line of split bolt connectors and service entrance connectors has been announced. The split bolt connectors are available in two types, "One Piece" and "Two Piece" with small and large heads. They are also available in bronze, brass, or aluminum. A wide range of sizes accommodates all solid and stranded wire from No. 6 to 1,000,000 CM. The service entrance connectors are made from cold drawn copper with the screws made from Everdur. There are five sizes from No. 12 solid or No. 10 stranded to No. 2 stranded. Ideal Industries, Inc., 1041 Park Avenue, Sycamore, Ill.

## Starting Panel

A new automatic starting panel for gasoline engine driven refrigeration compressors and pumps has been announced. It may be controlled by any 2-wire pressure, temperature float or manual control accessory. The panels are built to customer's requirement with standard automotive magnetic and manual electrical controls. Auxiliary devices such as engine starting solenoids, reverse current contactors and voltage regulators are also available for complete electrical control installations. This starting panel closes ignition circuit and energizes engine starting solenoid when control device closes, and de-energizes the engine starting solenoid after the engine fires and generator approaches rated voltage. When control device opens, control panel opens ignition circuit. R-B-M Division, Essex Wire Corporation, Logansport, Ind.




R-B-M STARTING PANEL

## Capacitor

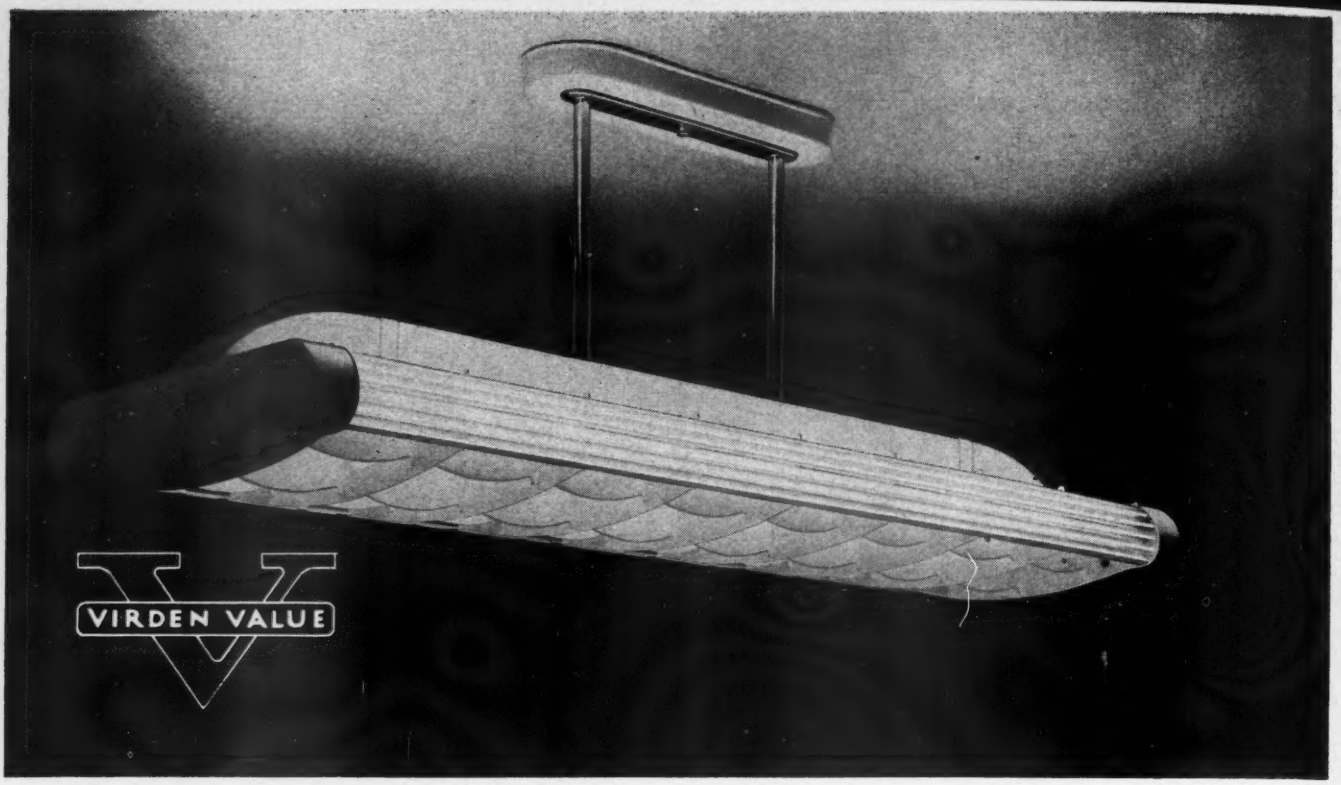
CORNELL-DUBILIER CAPACITOR

A new Type ETW capacitor has been added to this line of a-c electrolytic capacitors for motor starting applications. Units are designed for mounting with clip type bracket. This allows for the mounting of all sizes of capacitors with only two types of bracket. Capacity range is from 25 mfd. to 450 mfd. in four container sizes. Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

## Electrode Holders

TWECO ELECTRODE HOLDER

A new line of manual arc welding electrode holders, known as "Twecotong", is available. The line includes full-insulated and semi-insulated models. The full insulated models are known as No. A-14, 300 ampere, $\frac{1}{4}$-in. electrode capacity; No. A-38, 500 ampere, $\frac{3}{8}$-in. capacity. The semi-insulated models are known as No. B-14, 300 ampere, $\frac{1}{4}$-in. electrode capacity; No. B-38, 500 ampere, $\frac{3}{8}$-in. capacity. It is a conventional tong type holder, featuring indestructible molded-laminated glass cloth Bakelite insulation keyed to the holder casting. Tensioning spring seats on fibre upset washers and is protected from spatter by non-binding Neoprene tubing. Tweco Products Company, Wichita 7, Kansas.




*Four forty-watt lamps—every inch an inch of light*

# *Advance Showing of a new Beauty*

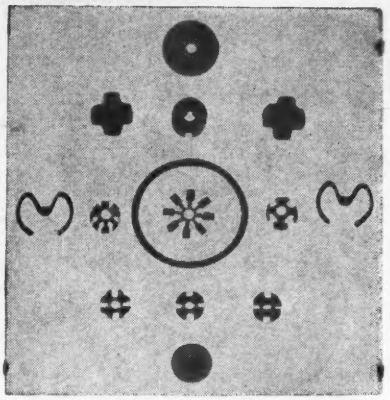
THIS preview of an important new Virden Fluorescent, broadly labeled commercial, but obviously suited by birth and appearance for a much wider range of society, positively and affirmatively answers the question—"Why can't a fluorescent fixture be a lovely thing that contributes pleasing atmosphere as well as pleasing light?"

Only a few "luckies" and "experts" have actually seen it. But truth is that this pearly beauty excites breathless interest that culminates in words like, "When can I get 'em?" "How many?" and other eager questions we can't answer correctly. Enthusiasm flares to a new high when they learn that it is priced competitively—a true Virden value.

**The John C. Virden Company • Cleveland, Ohio**

*Member American Home Lighting Institute*

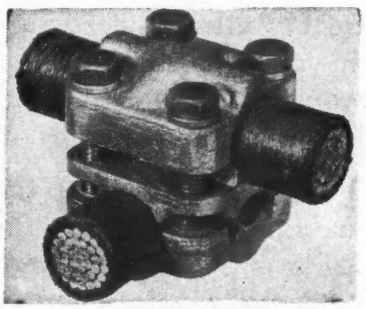
## Permanent-Magnet Materials



G-E PERMANENT MAGNET MATERIALS

Five new permanent-magnet materials, known as unico, cunife, vectolite, alnico 12 and silmanal, have been announced. These new materials have many applications in the manufacture of aircraft instruments, as well as other industrial uses where small, lightweight magnets formed in intricate shapes are required. Cunico is an alloy of copper, nickel and cobalt. Cunico magnets are made from rod, strip or wire stock. Cunife is a copper-nickel-iron alloy which has all the physical properties of cunico, differing in that it has directional properties and must be magnetized only along the direction in which the material has been cold-worked. Vectolite is a non-metallic, non-conducting magnet material. It is a hardened, sintered combination of iron rust and cobalt oxide mixed when still in powder form. Alnico 12 is made up of aluminum, nickel, cobalt, iron and titanium. Magnets made from this material can be used in such applications as in tachometer generators and electronic devices. Silmanal has a high intrinsic coercive force, which makes magnets made from this material useful in instruments where service in strong electrical fields is required. General Electric Co., Schenectady, N. Y.

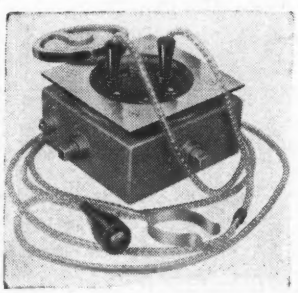
## Range Taps



FRANKEL RANGE TAP

A new line of range taps has been developed. Taps two cables at right angles or in parallel may be used as two-way. Five sizes of this tap cover a full range of cable combinations from 1,000 MCM to 1,000 MCM down to 1/0 to 6. The size shown will take 500,000 to 250,000 on main, 500,000 to 1/0 on the branch. This connector carries Underwriter approval. Frankel Connector Co., 27 Vestry Street, New York, N. Y.

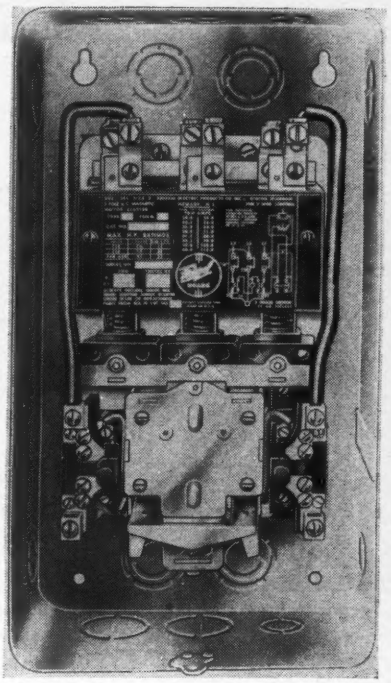
## Grounding Intercoupler



CANNON FITTING

A new grounding anti-static device for hospital operating rooms has been introduced. The fitting is known as the Type HE-6-70 hospital electrostatic grounding intercoupler. An eight inch square brass box with a hinged cover, and a phenolic insert with six SRB sockets connected to ½ megohm resistors, which are in turn connected by conduit to the water pipe, compose the fixed portion of the unit. Various combinations of bead chains covered with transparent plastic, together with plug and attachment devices such as plugs, separable connectors, leg or trouser clips, table clamps and spring clamps for all requirements, make up the removable group of accessories. Cannon Electric Development Company, 3209 Humboldt St., Los Angeles 31, Calif.

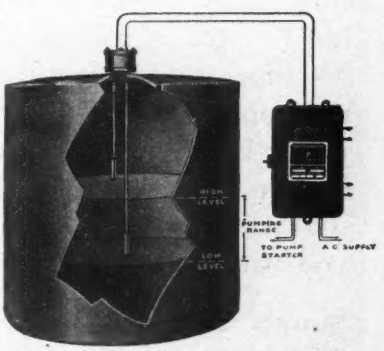
## Starters and Contactors



FEDERAL STARTER

New size 3 magnetic motor starters and contactors have been added to this line. They follow the same general design as the sizes 00, 0, 1 and 2. Double break silver contacts eliminate pigtails and flexible jumpers. Heavy arc barriers are strategically located. It is claimed that the straight line vertical operation with one moving part, guided by the Noark ball bearing feature, reduced friction to a minimum. Wire connection terminals are of the solderless pressure type. Federal Electric Products Company, Hartford, Conn.

## Level Control




PHOTOSWITCH LEVEL CONTROL

Level control Series 10 is a series of maintenance free relays for the level control of all electrically conductive liquids in the chemical, sanitary, sewage, and refrigeration fields. Contact with the liquid is made by a stainless probe rod. It operates on 115 or 230 volts, 50/60 cycles a-c and is a single pole, double-throw relay. Contacts are designed for motor starter, motorized, or solenoid valve operation. Selection from four terminals on the terminal block enables the control to be matched to the specific resistivity of a material. Photoswitch Incorporated, 77 Broadway, Cambridge 42, Mass.

# *This* TOUGH LITTLE TAP

## *Makes* GUTTER WORK A CINCH

## HINJON JUNIOR TEE PARALLEL TAP*

Demonstrate for yourself how easily it taps large mains to small branches.

Its compact, streamlined, one-piece construction makes it amazingly easy to install in any position, and easy to tape in hard to get at places. Tight spots where it's more handy to turn a screw driver than operate a bulky wrench. "You don't need three hands". There are no loose parts to spill. And you have the assurance that it is a permanent tap—for as long as you want it.

Simply slip your main into the large powerful self-adjusting jaws, and slip your branch into the small jaws. Tighten the one screw. That's all there is to it. Then bend branch to any position you want.

See for yourself how each cable is held tight by all-round pressures. Pull and haul on your branch for all you are worth. You won't be able to budge it. In other words, it's really vibration proof.

T&B Hinjon Junior Tee Parallel Taps are fully Approved by the Underwriters Laboratories. Each Tap takes a range of cable sizes: mains #8 to 1,000,000 CM to branches #14 to #1. Any type of conductor you may be using.

AVAILABLE NOW. For sale by T&B Electrical Supply Wholesalers through whom all T&B products are distributed exclusively.

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INCORPORATED
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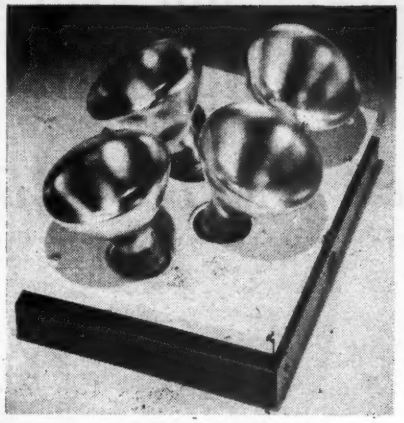
## Insulated Infra Red Units



MISKELLA PANEL

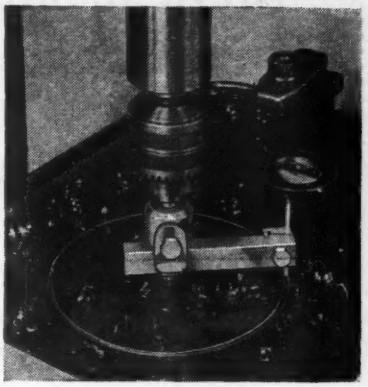
Insulated baking ovens can be constructed to conform to any desired lamp plan by using standard sectional interchangeable units which are quickly assembled. The sections have a width of 10¼-inches, a depth of 8¼-inches and a varying length of from 8¼ to 35¾-inches depending on the number of sockets per unit. Sections can be ordered without holes for completing an oven arrangement or they may be ordered with 1, 2, 4, 8 or 12 sockets. The units may be suspended vertically or mounted in any angular position either singly, side by side or end to end. The weight of the sections varies from 4½ to 20 lbs. White glass porcelain enamel is the standard finish for the faces of the units and gives a sanitary, non corrosive, non oxidizing, easily cleaned surface. Temperatures up to 600 degrees F. are possible by using 250-watt reflector lamps. The wiring for maintenance and servicing is readily reached through easily removed covers on the rear of the sections and the wiring can be specified for 115, 230 or 440 volts. Holes for lamps are punched diagonally to secure best distribution of heat rays and the insulated walls of the oven are quadruple in number. The Miskella Infra-Red Company, East 73rd and Grand Ave., Cleveland 4, Ohio.

## Truck Battery Charger

ELECTRIC PRODUCTS CHARGER

A single circuit battery charger for 60 cycle, 3 phase power supply is available for recharging 6 cell lead and 10 cell Edison batteries used for the motivation of industrial hand-lift trucks. Inserting a connecting plug starts the charging cycle which is controlled automatically throughout the process, shuts down in cases of power failure, resumes charging when power is restored and shuts off completely when the battery is fully charged. The units measure 12½ by 15½ by 23 inches, have motors of 1.5 and 3 hp., weigh from 150 to 180 lbs. and operate on charging time intervals of from 7 to 9 hours per battery charged. A 6-foot charging cable is attached to these units with vertical motor-generators and full voltage magnetic starters. The Electric Products Co., 1725 Clarkstone Rd., Cleveland 12, Ohio.

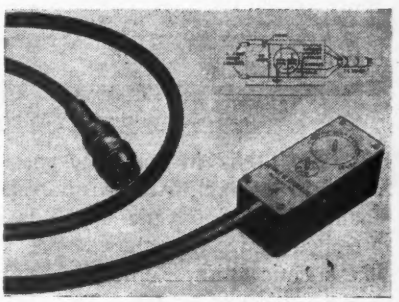
## Adjustable Circle Cutter



BRUNO CUTTER

A new all-purpose adjustable hole-cutting tool has been announced. It cuts holes to any diameter from 1⅞-in. to 8-in. through ¼ in. thickness in steel or tough metals and any thickness up to 1½ inches in plastics, fibre or wood. The tools are designed to operate in any standard drill press, woodworking machine, or mounted spindle machine. Cutter consists of a combination drill and pilot with an improved high speed cutting blade, adjustable to depth and diameter. Bruno Tools, Beverly Hills, Calif.

## High Frequency Probe



BARBER PROBE

Model 29 high frequency probe is designed to meet the need for a radio frequency probe with a low input capacity. With an input capacity of ½ to 1 micro-microfarad, it extends the range of measurements ten times, from 50 to 500 megacycles. It is adjusted to one-tenth the sensitivity of the standard probe. Consequently, all voltage readings are ten times the indicated values. With Model 29 probe, Model VM-27 voltmeter has full scale ranges of 10, 30, 100, 300 and 1000 volts. Alfred W. Barber Laboratories, 34-14 Francis Lewis Blvd., Flushing, N. Y.

## Insulation Tester

RADIO CITY TESTER

This new insulation tester is known as the "Billionaire", as the range is up to 10 billion ohms. The instrument includes a vacuum tube voltmeter, ohmmeter and capacitymeter, covering 29 measurement ranges for laboratory or service testing jobs. Motor is 8 inches overall. Automatic line voltage check provides a-c as well as d-c regulation. An automatic ohmmeter battery check maintains accuracy of low range ohmmeter. Model 665A is 9¾ by 12½ by 6 inches. Radio City Products Co., Inc., 127 W. 26th St., New York, N. Y.

# There is More Reason Today Than Ever Before to Specify Benjamin Lighting Units with *Porcelain Enamel Reflectors!*

***The many important advancements made in all types of reflector finishes have left unchanged the 3 BIG REASONS for Porcelain Enamel's TOP RATING!***

Advancements in porcelain enameling make possible lighting reflectors with even greater resistance to weather, chipping, acids, thermal shock, etc. However, while these advancements give added reason for its specification, basically the reasons for its TOP RATING remain the same. They are:

## 1. DURABILITY

TOP RATING in durability goes to porcelain enamel. Reason: porcelain enamel is an inorganic finish, being literally rock fused on steel. Hence, unlike organic finishes, porcelain enamel is *not subject* to oxidation and deterioration from the effects of time, heat, sunlight and atmospheric conditions.

## 2. REFLECTIVITY

TOP RATING, here, because with porcelain enamel you get a lighting unit which not only has a light diffusing reflection factor of 80% or more, but also one that will *retain* this efficiency for a *life-time*. For, although the better organic finishes now possess initial qualities of reflectivity the equal of porcelain enamel, only porcelain enamel has been so completely time tested. Years and years of service experience prove that porcelain enamel retains its light reflecting qualities throughout a life time of service without appreciable loss.

## 3. CLEANABILITY

TOP RATING goes to porcelain enamel. Because its dense, glass hard surface prevents dirt and oils from becoming embedded . . . because of its extreme resistance to scratches, marring, chipping . . . because it cannot oxidize or corrode . . . porcelain enamel surfaces are the most easily cleaned; require only soap and water washing.

***ENAMEL SEALS AGAINST CORROSION***

**To be Sure you Get Reflectors Embodying the Latest Developments in Porcelain Enamel . . . Specify BENJAMIN LIFE-TIME PORCELAIN ENAMEL REFLECTORS . . . Years of pioneer leadership in the development of special light reflecting enamels and finer production methods employed in Benjamin's own porcelain enameling plant insures porcelain enamel of a uniform quality that is warranted to meet all recognized industry specifications including those of the RLM Standards Institute.**

*Remember:* For Durability . . Reflectivity . . Cleanability . . *Specify*

**BENJAMIN** TRADE MARK

**LIFE-TIME PORCELAIN ENAMEL**

*Lighting Equipment*

DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS

**BENJAMIN ELECTRIC MANUFACTURING COMPANY**

**DES PLAINES, ILLINOIS**

# Selecting Industrial Control—Part IV

**Reduced voltage starters, transfer switches, special control panels and enclosures are discussed in concluding this series.**

By Richard Pitt Ballou
*Chief Engineer*
*Federal Electric Products Co.*

### Reduced Voltage Starters

Even very large motors are sometimes started by connecting them directly across the line. There are just three reasons for not doing it with all motors: the line, the load, and the motor.

(1) The starting current of large motors may create an excessive line drop. This may interfere with other motors on the line, or it may be so great that the motor's own starter will not stay in. Or it may interfere with other circuits to the extent that the power company will not permit the surge.

(2) Sometimes the load is of such a nature that it would be damaged by the sudden high torque of across-the-line starting.

(3) Especially with high inertia loads the starting time is likely to be so great as to cause overheating of the motor and tripping of the thermal or magnetic overload relay if full voltage starting were used.

When the objection cannot be overcome by altering the load during the starting period a reduced voltage starter is generally indicated. There are two general types: resistance and auto-transformer.

The resistance type starter, as its name implies, starts the motor with a resistance in series with the line. This is automatically cut out in one or more steps and the motor finally runs across the line. Sometimes a compression type resistor is used, and this gives a smooth decrease in resistance; otherwise taps for adjustment of the resistance are usually provided.

The autotransformer starter makes use of an open delta auto transformer, with taps. Generally there is only one starting and a running position but taps can be changed.

In comparing the two it should be noted that since the resistance has no *induced* voltage in it, it can be shorted for the running position, whereas the auto transformer must have its circuit opened first so the line surge is worse when transfering to the running position. Also, since the voltage drop across the resistor decreases as the motor comes up to speed and its current decreases, the voltage across the motor thereby rises automatically. In the transformer type the voltage remains constant. However, in the resistance starter the motor current is the same as the line current, whereas with the transformer it is inversely proportional to the transformation ratio; therefore a higher starting torque for a given line current is produced with transformer type.

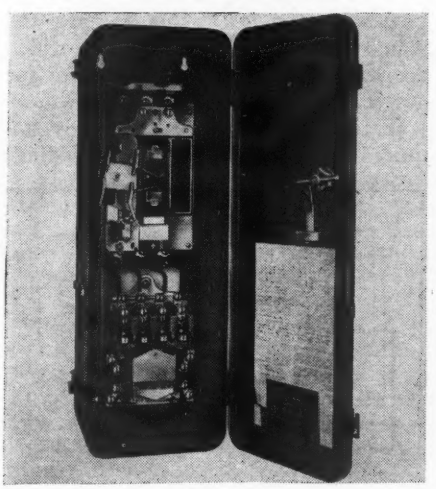


***Fig. 1—Combination disconnect and magnetic starter in dust-tight enclosure.***

Thus it is seen that better starting characteristics are obtained with the resistance type starter, but a lower line current is obtained with the transformer. As might be expected, then, the resistance starter is more suited for small or medium motors, and the transformer for medium or large motors. As a general conclusion it may be observed that the transformer starter is used when line current must be kept to a minimum; otherwise the resistance type will probably be the choice.

### Combination Starters

Magnetic motor starters are supplied in combination with a disconnect switch, either with or without provision for fuses. Such a device saves space as well as time in wiring, and where remote control is used the starter can generally be located in a position where its size is of no importance. Even with local control there are many applications where the increase in size necessary to accommodate the disconnect switch causes no inconvenience.

The choice between fusible or nonfusible generally depends on the plant layout. Some installations bring the individual branch circuits from a fuse cabinet, conveniently located for the replacement of the fuses. In this case only the disconnect switch is required. Others run heavy feeders or sub-feeders and tap off the individual branch circuits as needed—indicating a fusible combination starter.

Combination starters are also made with a circuit breaker in place of the fused safety switch. While the original cost is more, there are no fuses to replace. This may be an important item, both in saving fuse costs and replacement time (which includes idle machine

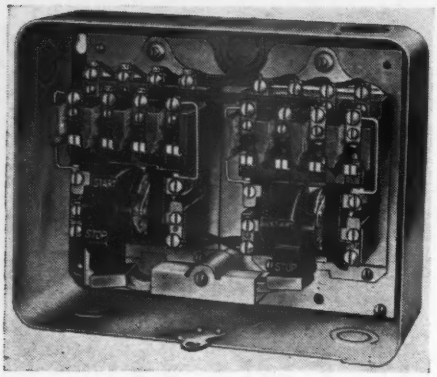


**FIG. 2—Manual reversing starter with mechanical interlock.**

time) especially if short circuits are frequent.

Practically all polyphase motors operate equally well in either direction, and reversing is easily accomplished. With three phase motors it is only necessary to interchange any two wires. Three pole starters generally interchange L1 and L2, which are the leads containing the overload relays, and such a starter is suitable for 3 phase, or for 2-phase 3-wire circuits, L3 being the common phase line. In the case of 2-phase 4-wire circuits it does not matter which phase is reversed. Single phase motors can be reversed if a sufficient number of leads are brought out, and the number of poles required on the starter will vary from 2 to 5, depending on the type of motor, and whether it is desired to break both sides of the line or only one. Full information, including a wiring diagram of the motor, should be furnished with orders for reversing starters for single phase motors.

*Manual Starters*

One type of manual reversing starter incorporates two starters with a mechanical interlock so only one starter can be thrown ON at a time. When the motor is running in either direction its running switch must first be thrown off before the other switch can be moved to operate the motor in the other direction. Each starter has its two built-in thermal latches for overload protection, and four heaters of the same rating are required.

*Magnetic Starters*

Magnetic reversing starters use two contactors with a mechanical interlock that prevents more than one from being in the ON position at the same time. In addition, it is customary to electrically interlock the control circuits so only one coil can be energized at a time. Only one pair of overload relays is required to afford protection to the motor in either direction of rotation. This is done by connecting the relays in the common wire of the control circuit (such as between L3 and the coil).

Reversing starters and contactors can also be supplied in combination with a fusible or non-fusible disconnect switch, or an air circuit breaker. Thus the advantages of the Combination Starter, previously discussed, can also be obtained for applications requiring reversing.

**Automatic Transfer Panels**

There are many applications where a voltage failure of more than a second or two cannot be tolerated, and automatic transfer panels are used to maintain a continuous power supply by switching from the normal source, if it should fail, to a stand-by or auxiliary source. The usual time required to effect the transfer is less than one-tenth of a second.

Among the applications requiring con-

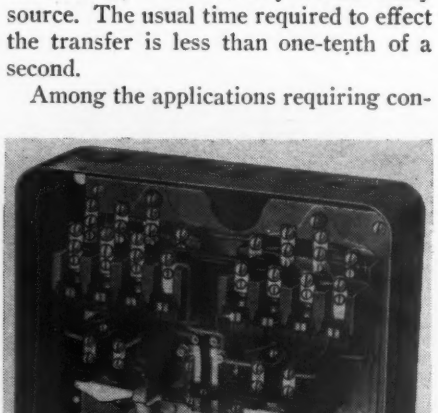


**FIG. 3—Automatic transfer switch with mechanical interlock.**

tinuous power are lighting and ventilation for hospitals, theatres, and tunnels; blowers for exhausting poisonous fumes in chemical plants; conveyors for heat treating and drying in closely controlled processes; and for vacuum pumps and many other industrial processes which are required to run continuously, or for a specified period without shutdown.

Transfer panels are frequently required by law in certain public buildings in order to maintain at least emergency lighting and avoid panic in large gatherings, and their necessity in operating rooms has long been recognized. However, it is only recently that their value has been appreciated on an increasing number of industrial applications. A specific example is found in the manufacture of large electronic tubes for radio transmission, X-ray, etc. Heat treating, bombardment and vacuum pumping of such tubes may go on simultaneously for several days. Here a loss of power for a few minutes might cause a loss of vacuum necessitating the repetition of several days work; or by too rapid cooling it might cause irreparable damage amounting to several thousand dollars. There are many other places in industry where investment in a transfer panel and an emergency power line might be economically sound even though it did not function more than once a year.

Transfer panels are fully automatic. They consist of two magnetic contactors, mechanically interlocked, and a pilot relay. The contactors are wired to be connected to two sources and supply a common load.

Whenever there is power at the preferred source the pilot relay is energized. This relay connects the coil of No. 1 contactor to the line of the preferred source, and this contactor is energized, supplying the load from the normal line. If this power fails both the contactor and pilot relay open, and the pilot relay in its open position connects the coil of No. 2 contactor to the line of the auxiliary source, and this contactor is energized, supplying the load from the emergency source. When power is restored on the preferred mains the pilot relay picks up, causing No. 2 contactor to open and No. 1 contactor to close, thereby transfering the load back to the normal supply line.

Besides being mechanically interlocked, both contactors are electrically interlocked with normally closed contacts on the opposite contactor.

Auxiliary contacts are available for operating relays, pilot lights, alarms.

To prevent the transfer to the emer-

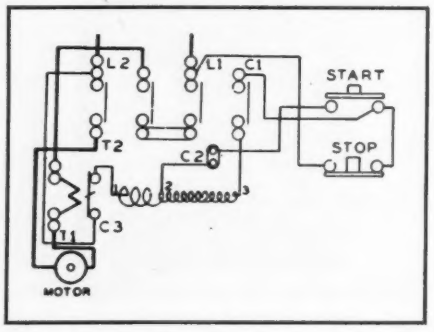



**FIG. 4—3-wire remote control connection to magnetic starter.**

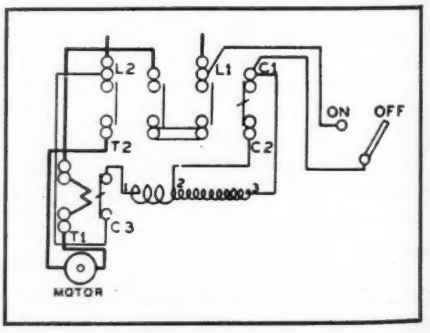



**FIG. 5—2-wire remote control connection to magnetic starter.**

**FIG. 6—Magnetic contactor in dust-tight sheet steel enclosure.**

gency source when the preferred source flickers frequently but does not actually go off, an adjustable time delay relay can be installed. Such a relay can also be used to control the return to the preferred source by requiring that the preferred source be energized for a specified time before the transfer back is effected.

### Special Control Panels

A special control panel is generally indicated whenever several motors, valves, heaters, solenoids, or other electrical devices are to be automatically controlled in a predetermined manner, or where a timed or interlocked relationship is required with them. Typical examples are machine tools (sometimes even very simple ones) and machinery for processing, handling, or conveying materials. Typical assemblies consist of starters, contactors, circuit breakers, timing relays, transformers, fuses, push buttons, and other equipment as required, properly mounted and wired, either on a steel plate for mounting in a machine, or in an enclosure suited to the application.

*Advantages of Custom-Built Control:*

1. All control is centralized for easy inspection and servicing.
2. Expert factory wiring facilitates tracing of circuits for checking or alteration.
3. Terminal blocks, numbered with the wiring diagram, assure easy removal and accurate replacement of the entire panel.
4. Starters are mechanically interlocked where necessary.
5. All necessary auxiliary contacts and relays are included, of the right size and type.
6. Transformers, auxiliary relays, etc., are conveniently located for wiring and observation.

### Operation on Direct Current

Any contactor requires more power to close it, than to maintain it closed. In the case of a-c this condition is effected automatically by the change in reluctance of the magnetic circuit, so that the sealed current is about one-fifth of the inrush current. However, when the coil is operated on direct current, the value of the current is determined solely by the ohmic resistance of the coil and the power required to close the contactor would usually burn out the coil if it were allowed to remain at that value very long. To prevent this, it is customary to "economize" practically all d-c coils except those on very small relays. This is done by a series resistor and a normally closed contact on the contactor or starter. When the starter is open this contact is closed and shorts out the resistor; when the starter is closed this contact is open and the series resistor is in the circuit.

Power contacts for d-c are heavier, and

***FIG. 7—Weather-proof and water-tight enclosure on local control magnetic starter.***

the break distances longer, than for a-c. This is usually compensated for in the case of small starters by putting two or three poles in series, but for the larger ratings a special contactor design is usually more practical.

The National Electrical Manufacturers Association (NEMA) has established certain standard types, mainly with respect to performance and recommended application, but no company manufactures all of these enclosures for any one device, and many devices are made in only two types of enclosure.

Some companies designate their enclosure types directly by the NEMA number, but others find it more practical to assign letters to the types which they manufacture and to describe these in terms of the NEMA numbers. The type letter is frequently used in the nomenclature or catalog number, and has the further advantage that it avoids confusion when a manufacturer has one design that covers several NEMA types. There is, obviously, no correlation between the letters used by the different companies for this purpose, and the construction, even with the same company, may differ according to the nature of the device to be enclosed, or its size.

Equipment is usually manufactured with a choice of several types of enclosures and mountings. The following are the most important of those now being furnished standard by our company.

A general purpose, sheet steel enclosure, with knockouts. These are attractive in appearance, with round corners, removable covers, and machinery gray finish procured by a baked-on enamel over a Bonderized surface.

A semi-dust-tight enclosure, with a felt gasket between cabinet and cover to retard the entrance of dust, small metal chips, and other foreign matter that may be present in the air or around machinery. (NEMA Type IA)

A dust-tight sheet steel enclosure, with knockouts, external mounting feet, and gasketed cover secured by wing nuts. Especially suitable for cement mills, steel mills, etc., it is designed to meet the requirements of the National Electrical Code for non-hazardous dust locations. (NEMA Type V)

Weatherproof and watertight, a cast aluminum enclosure with live rubber gaskets and cover secured by wing nuts or bolts. It is suitable for both indoor and outdoor use, as on docks, in construction work, in tunnels, and in dairies. (NEMA Types III, IV, V)

Explosion resisting, for Class I Group D hazardous locations. A cast enclosure, the cover is either screwed or bolted on with machined flanges and no gaskets. (NEMA Type VII)

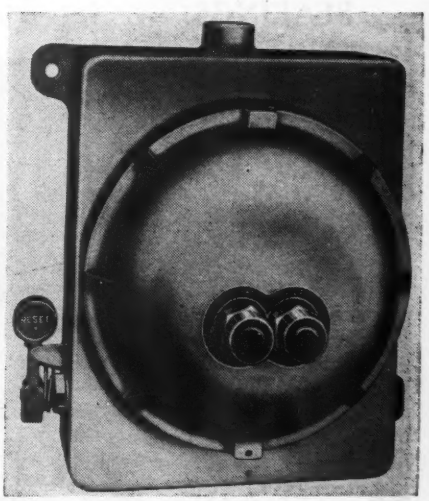
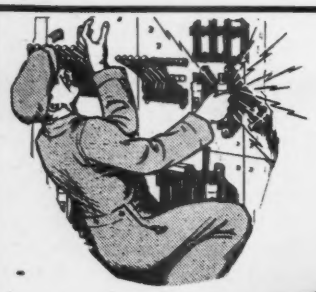



***FIG. 8—Explosion resisting enclosure for Group I. Class D, hazardous areas on local control contactor.***



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- Handy for adjusting switch and fuse clips.
- Recommended by world's leading safety engineers.

**Pulling fuses by hand can result in severe injury, shocks, burns, infections, and even death. Avoid all possibility of injury, lost time, compensation costs and lawsuits . . . USE TRICO FUSE PULLERS!**

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- Hang one at every switchbox.
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- Every fuse box should have one.

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- End bearing failures.
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*Write for*
CATALOGUE

***FIG. 9—Flush mounting sheet steel enclosure specially designed for mounting in machine frames.***

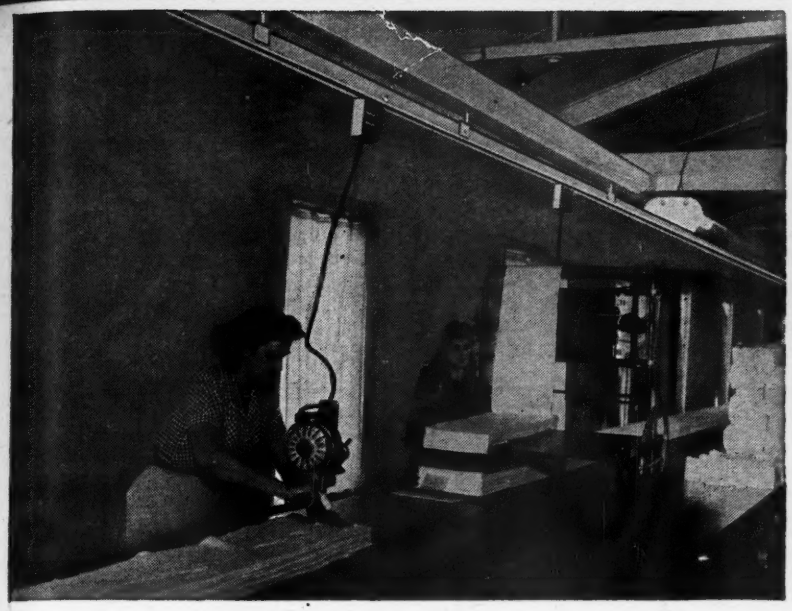
Flush mounting, particularly suited for use in the frame of a machine. (NEMA Type IB) Yoke mountings of various kinds are also available, but the yokes are sold separately for attachment to open starters.

A dust-tight cast enclosure, with threaded pipe fittings and securely attached cover designed to meet the requirements of the National Electric Code for use in hazardous dust locations. (NEMA Type IX)

A sheet steel enclosure, larger than standard, available for only a limited number of small devices. This oversize cabinet meets special requirements for extra wiring space, or to make a Size0 manual starter line up with a Size 1 manual or a Size 0 or 1 magnetic starter. (NEMA Type I)

Special enclosures can be furnished to meet almost any need, but if at all possible standard enclosures should be selected. Special enclosures are expensive. All standard enclosures are usually available from stock.

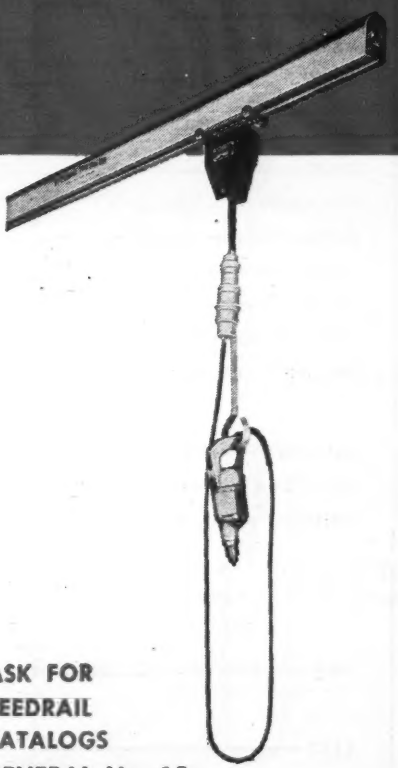
***Electronic control for a wound rotor motor intrigues this group of maintenance men at recent Milwaukee EME Industrial Electrical Show. Charles Sims (right), sales engineer, Cutler-Hammer Co., explains its operation.***



FEEDRAIL used for cutting machine and moving cloth laying machine with inspection light.

# KEEP TOOLS AND CABLES OFF THE FLOOR *with* ELECTRIC FEEDRAIL

FEEDRAIL supporting high-cycle portable tool and balancer in machine shop



FEEDRAIL is an enclosed electric busway system that supports and feeds portable tools. Heavy duty FEEDRAIL trolleys may be equipped with counterbalances to help support the tools. A dead-front fuse block on each trolley or EVER-LOK connectors provides individual protection for high cycle or universal tools.

All electrical contacts are enclosed, and protected from mechanical injury and dust and the system is grounded. Each section carries the Underwriters' Label.

Keeps cables and tools off the floor — no accidental disconnection — no delay — and safety everywhere.

FEEDRAIL is ideal for modernization of any plant that requires production changes from time to time. Also for moving test lines, monorails, cranes and hoists.

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ELECTRIC FEEDRAIL

**FEEDRAIL CORPORATION**

*Subsidiary of Russell & Stoll Company*

125 BARCLAY STREET NEW YORK 7, N. Y.

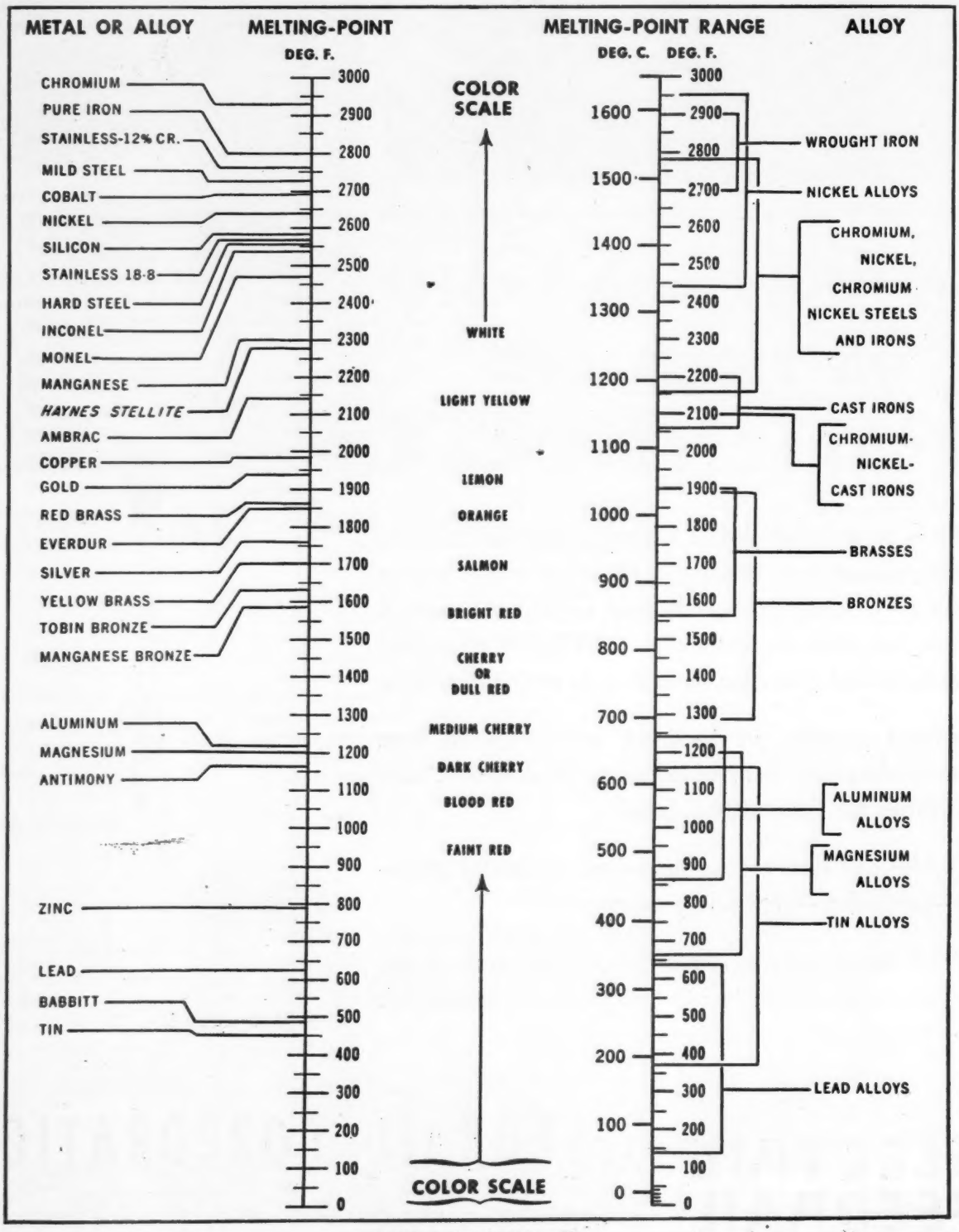
# DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

**H4**

## Melting Points of Metals and Alloys

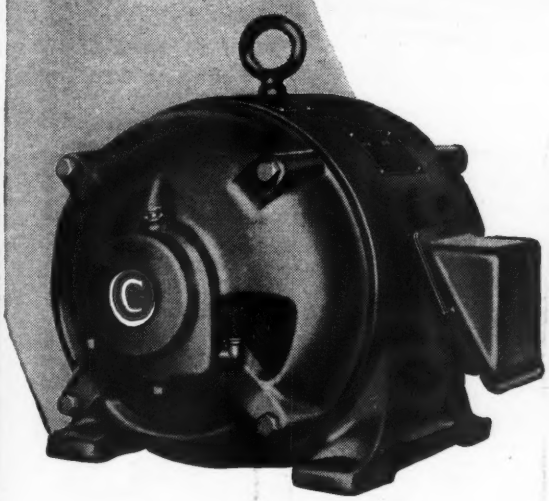
The melting points of those metals and alloys that have a melting point range narrow enough to be considered a single temperature are given in the left hand column. The melting points of various alloys having a wide range appear in the right hand column. The color scale in the center shows the approximate temperatures at which color changes appear. The color scale is purposely indefinite as to the border line between colors, because of the difference of opinion as to color names, and because the amount of light present affects the color seen. In a well lighted shop, faint red may not appear until the metal has reached a temperature of 1,100 or 1,150 deg. F.




*Data from Oxy-Acetylene Tips*

Century 7½ horsepower type SCH and 3 horsepower type SC motors driving a steel plate forming machine.

# Whatever the Torque Requirement . . . There's a CENTURY MOTOR for the Job . . .



The motor application on the plate forming machine shown above is a good example of Century motors properly applied. There are two separate drives, each having a different power requirement.

The power rolls that force the steel plate through this machine require a motor that starts against a heavy load. A Century type SCH motor with high starting torque and low starting current is used.

The adjustable roll that controls the curvature of the plate requires a standard general purpose Century type SC motor with normal starting torque.

Correct application of these two motors means that the steel plate roller gives top performance and a maximum of output.

If your machines require electric motors from 1/20 to 600 horsepower, investigate Century. Specify Century motors on all your electrically powered equipment. Engineered to the functional characteristics of the machines they drive to assure top performance — Century motors are a vital factor in producing a better product at a lower cost.

Century C MOTORS

476

**CENTURY ELECTRIC COMPANY** • 1806 Pine Street • St. Louis 3, Missouri

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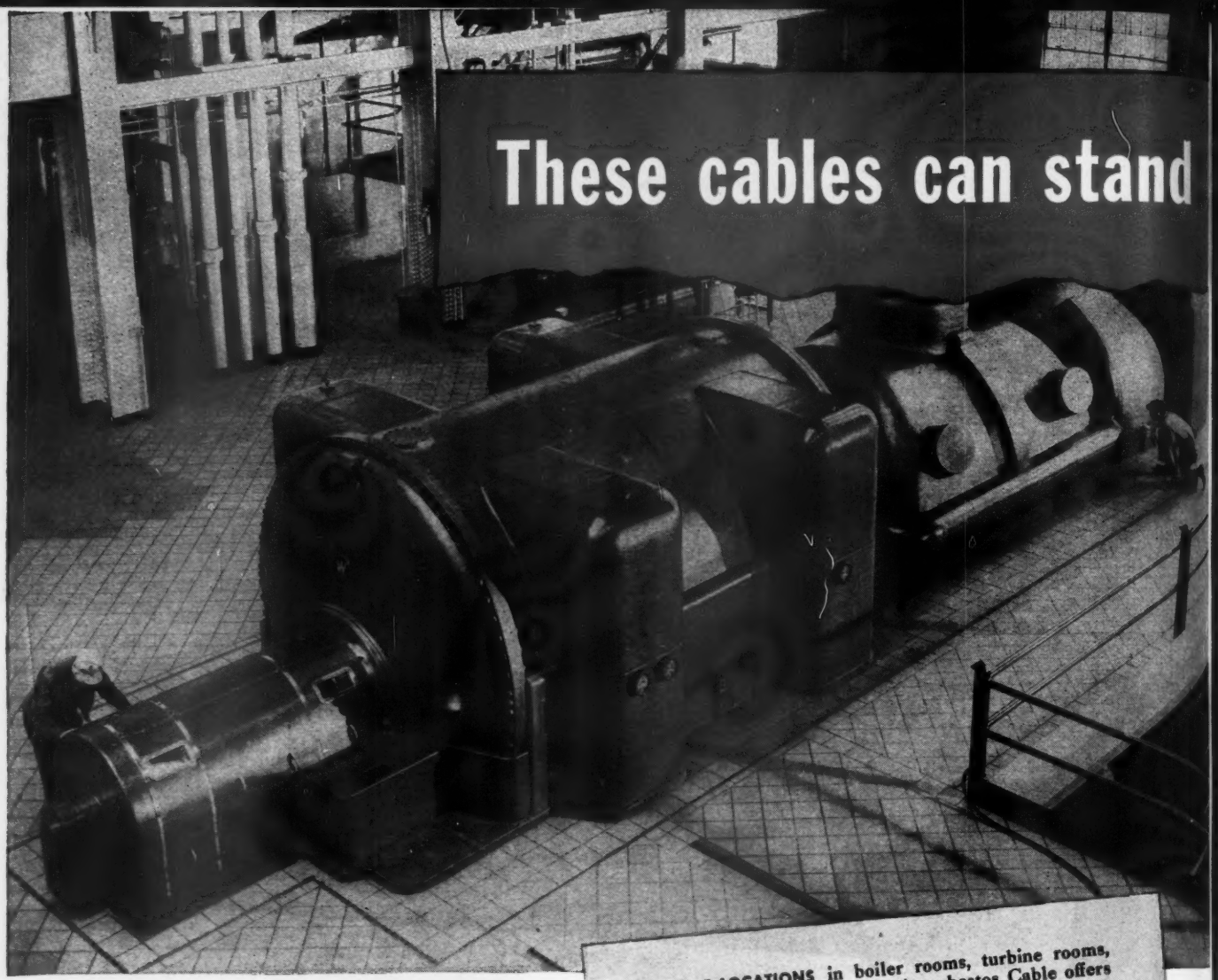
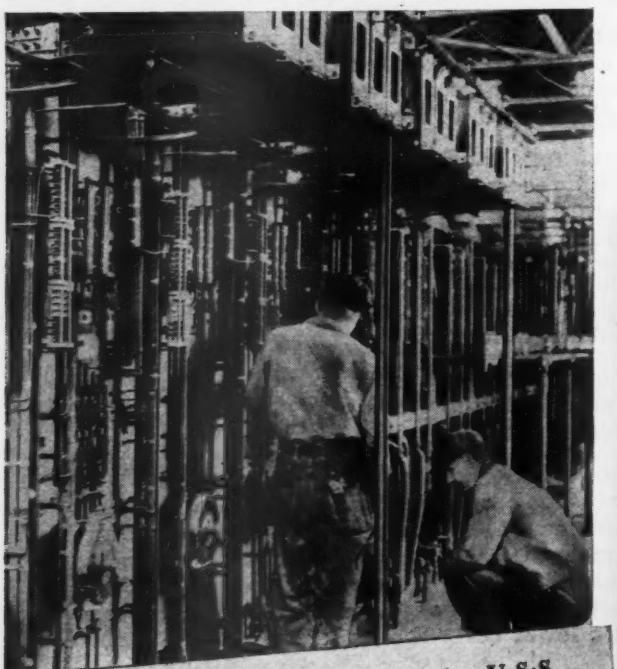
# These cables can stand



**FOR HOT LOCATIONS** in boiler rooms, turbine rooms, locomotives and ships U·S·S Amerbestos Cable offers long trouble-free service.

**FOR HIGH TEMPERATURE** industrial furnaces, ovens and other mill applications U·S·S Amerbestos is unsurpassed for both power and control uses.



**FOR SWITCHBOARDS** and control wiring U·S·S Amerbestos is flexible and easy to bend at right angles without damage to the insulation.

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**U·S·S AMERBESTOS is built to resist extreme heat . . . flame . . . corrosive fumes . . . moisture . . . oil and grease**

ELECTRICAL CABLE is literally "cooked" in some applications, but in spite of all this rough treatment, U·S·S Amerbestos Cable can be counted on to give all-round fine performance. It is widely used for power plants where resistance to torrid heat and moisture is required. Its permanent flexibility recommends it for electric ranges, furnaces and ovens. The resistance of Amerbestos to oil, grease, flame and corrosive fumes has resulted in its extensive use for locomotives, switchboards, control wiring and steel mill applications.

Amerbestos Wire and Cable of all types are insulated with felted asbestos which is spun around the copper conductor, impregnated with flame-proof insulating compound, and compressed into an insulating sheath. The covering is firm, uniform and seamless. It will not unravel nor disintegrate; yet it can be stripped easily and cleanly from the conductor.

When more dielectric strength is needed, a layer of superior heat-resisting varnished cambric and a second layer of asbestos felt are added. Where resistance to moisture, oil, grease and fumes is necessary, the cable is impregnated with MFH black saturant.

If you need electrical wire and cable of *any* kind, standard types or tailor-made cable engineered for your particular job, get in touch with us. We probably have, or can make what you need.

Asbestos, varnished cambric, asbestos and asbestos braid. Resists heat, flame, moisture, oil, grease and corrosive fumes and has high dielectric strength.
Typical all-asbestos construction. May be subjected to extreme heat, oil, grease, corrosive fumes.
Smokeless asbestos, for electric ranges, furnaces, and other heating appliances.

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- ★ Ampyrol—Synthetic-insulated wire and cable for switchboards and machine tools.
- ★ Amerclad—Tough abrasion resisting cable for portable tools, motor leads, power cable.

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## U·S·S American Amerbestos Wire & Cable

**QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.**

# Reader's Quiz

## DEMAGNETIZATION

*QUESTION 219—We have a 10 kw. m-g set which persists in losing its residual magnetism. On many occasions I have noticed a "ground" on the a-c system and have assumed this to be the cause of the demagnetization. Am I correct?—T.B.*

A. TO QUESTION 219—It might be possible for a ground on the a-c system to cause this trouble; however, there would have to be a tie-up between the magnetic circuits of the a-c and the d-c machines, i.e., they would have to be mounted close together on a metal chassis or base in order for the disturbance to affect the d-c machine. However, I would suggest that the following items be checked in the process of investigation—first the possibility of a short circuit or short circuiting ground in the d-c load system. Second, the possibility of nearby d-c machinery affecting the generator field, and third, the remote possibility of the interference set up by the earth's magnetism with the residual magnetism. This, however, is not logical unless the machine is unused for a long time.—W.R.S.

A. TO QUESTION 219—The a-c system does not affect the generator. I would blame the trouble on a reversed field, a high resistance field, or a d-c overload. The d-c overload pulls down the voltage on the field, so we blame the residual magnetism. The best practice is, first open the d-c switch, then the a-c switch; to start, close the a-c then the d-c switch after the d-c generator is up to full speed.—H.S.

## SOIL HEATING CABLE

*QUESTION 220—A store in upstate New York has a 100 ft. frontage with sidewalk 12 feet wide which must be relaid very shortly. We are exploring the possibility of installing soil heating cable to keep the walk free from ice and snow. I would like to know something of the experience of others with this kind of job. Is it practical? What size and length of cable should be used? How many kilowatts would it take?—S.W.*

A. TO QUESTION 220—This question is regarding the use of soil heating cable to keep a sidewalk 12 ft. wide and 100 ft. front free from ice and snow. Several years ago a test slab of concrete was poured with soil heating cable installed to see what would be necessary in this climate for that purpose. Tests were made during the course of one winter. They indicated that to be reasonably sure of doing a job, somewhere between 20 and 30 watts per square foot of heating cable would have to be installed. It is difficult to say exactly what is necessary because conditions of wind, sunshine and other weather factors enter so intimately. However, a wattage loading of the range indicated should give quite satisfactory results, except possibly in very severe weather.—E.A.B.

A. TO QUESTION 220—Please refer to Rockbestos catalog which shows pictures of heating cable installed in a sidewalk to keep it free from ice and snow.

"Industrial heating cable was embedded one inch below the surface of a concrete walk, laid out to a 40 watts per square ft. consumption. This provided an estimated temperature rise of 20°, which eliminated snow and prevented ice formation at temperatures as low as 15° F. above zero."—J.M.T.

## NEUTRAL WIRE

*QUESTION 221—How much current does the neutral wire carry when all light circuits are balanced on a 4-wire 120/208 volt system? Answers received some time ago indicated that the neutral carries no current. It is found that by disconnecting the neutral on a balanced system, the lights will dim as the effects will equal two lights on 208 volts or 104 volts to the lamps. If neutral carried no current, why should this take place?—L.G.D.*

A. TO QUESTION 221—An interesting answer to this question can be obtained by installing lamps on a four wire system and taking readings of voltage and amperes.

Using 50 watt lamps (110 volt), two in series across a 208 volt line with no neutral, the voltage across each lamp will be 104. If the neutral wire is connected to the center connection of each two lamps in series, 120 volts will be established across each lamp and the lamps will burn with greater brilliance.

In this case no current will flow in the neutral wire.

If one lamp is removed, unbalancing the load, approximately .45 amps. will flow in the neutral wire and .47 amps. will flow through each lamp.

If the two lamps are removed from across one phase, the neutral still carries .45 amps. but if a third lamp is removed so that three lamps are burning, a lamp between each of the three phase wires and the neutral, the line becomes balanced again and no current flows in the neutral wire.

If the neutral is disconnected from the source of power but remains connected to the lamps, the lamps will burn as brightly as when the neutral was connected. However, if you unbalance the load under these conditions, unequal voltages are impressed upon the lamps, 20 percent overvoltage in some cases.

This test proves that the ideal condition is to use a neutral wire when possible in case the load is unbalanced.

There is no current in the neutral wire of a balanced system because equal and opposite voltages are set up along the neutral wire preventing the flow of current.—B.A.S.

A. TO QUESTION 221—L.G.D. specifies two lamps in his query. This implies one on each of two phases leaving the third phase unloaded. The

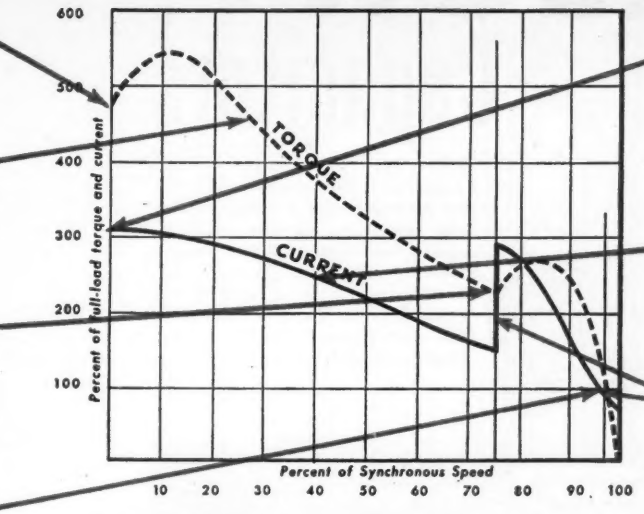
# This Chart Shows Why There's Such a Strong Preference for Wagner Repulsion-Start Induction Motors

Starting-torque of the RA motor is very high—at least 3½ times full-load torque for a 4-pole 60-cycle motor—enabling the RA motor to start high-inertia loads.

Torque output of the RA motor remains high during the starting period, assuring rapid and smooth acceleration of the load.

When the torque as a repulsion motor drops to that of an induction motor, the motor is changed from a repulsion motor to an induction motor by means of an automatic mechanism built into the rotor. During the pull-in period, the torque again rises—to more than twice the full-load torque.

Full-load torque is reached at 96% to 97% of synchronous speed. *The speed decreases very little even under considerable overloads,* a highly-desirable characteristic of the Wagner type RA motor.




Typical speed-torque and -current curves of a Wagner Type RA repulsion-start induction motor. These curves show how the type RA combines the desirable features of the repulsion and induction types of single-phase motors, while it at the same time excludes their deficiencies.

Starting-current of the RA motor is lower than any other type of single-phase motor—approximately three to four times full-load current. Thus light-flicker is negligible when the RA motor starts.

Current-draw decreases rapidly and smoothly as the motor accelerates, remaining far lower than that of other types of single-phase motors.

At the change-over point where the RA motor is automatically changed from a repulsion to an induction motor, the current-draw increases—but to less than the starting-current—and then drops rapidly as the motor attains full-load speed.

The world over, Wagner type RA repulsion-start induction motors are in strong demand—and the preference for this type of motor is growing rapidly.

Fifty years ago, Wagner began building repulsion-start induction motors, and notwithstanding the development of other types of single-phase motors during the past half century, the repulsion-start induction type RA is still the preferred motor for a wide field of appliances and machines.

As the chart shows, the RA's electrical characteristics combine the best features of two types of motors: the repulsion motor while starting and the induction motor while running.

*As a repulsion motor, the Wagner type RA has*

1. a high starting-torque, enabling it to start high-inertia loads and accelerate them smoothly, and
2. the lowest starting-current of any type of single-phase motor, therefore least likely to cause light flicker.

*As an induction motor, the Wagner type RA has*

3. fairly constant and high operating-speeds at all operating loads, even under considerable overload, and
4. a fairly flat efficiency curve over a wide operating range.

This versatile motor is not only exceptionally suited for use on practically every type of motor-driven appliance and machine normally utilizing single-phase current, but is also the *only* choice for wide variety of applications.

For complete information, write for Bulletin MU-185, and address your request to Wagner Electric Corporation, 6413 Plymouth Avenue, St. Louis 14, Missouri.

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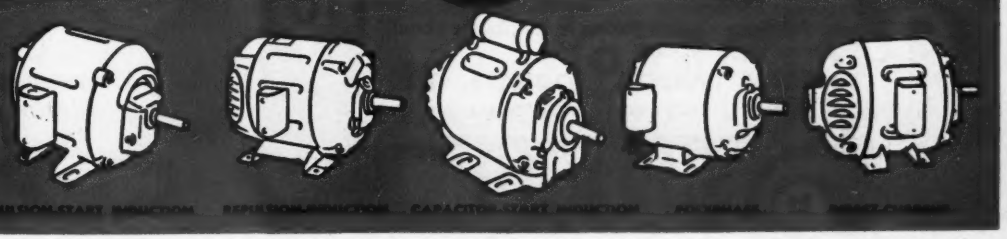

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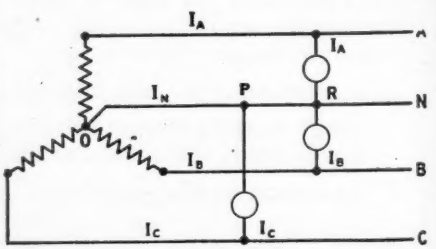
system is therefore unbalanced and the neutral wire must carry the return current which is the vector sum of the current through each lamp. This resultant current is equal in magnitude but opposite in direction to the current that would flow through a lamp placed in the third phase and connected to the common wiring junction of the other two lamps.

The questioner is correct in his conclusion that, with two lamps and the neutral disconnected, he has 208 volts across the two lamps in series or 104 volts across each lamp. However, when the neutral point of the transformers is connected to the common side of the lamps, 120 volts is established across each lamp.

With one lamp on each phase, the currents neutralize each other at the common junction and, the voltage drop across each lamp being equal, a neutral point is established exactly equal in potential to the common point of the transformers. The neutral wire, therefore, carries no current and could be disconnected with no effect on lamp brilliancy.—J.R.H.

**A.** TO QUESTION 221—With a 3-phase 4-wire 120/208 volt system supplying a balanced load, the neutral will carry no load. This means, of course, that the load must be balanced on all 3 phases. If load is balanced between neutral and two phase wires, it will result in a current in the neutral equal to the load current. If the neutral is opened in such a case the two single phase loads will be connected in series across 208 volts as indicated. If an equal load is connected from the common neutral point to the third phase




wire, the balanced condition will be restored, the three loads will each be operating at 120 volts and if the neutral is reconnected, no current will flow in it.

It must be understood that the loads must be really balanced. Any unbalance will result in lower voltage for the larger load and higher voltage for the smaller load (when neutral is disconnected).

In the sketch, currents $I_a$, $I_b$ and $I_c$ must be equal. If neutral N is opened between O and P conditions will be still balanced, but if neutral is opened between P and R the load connected to C will be O.K., but loads connected to A and B will now be in series across 208 volts. The same condition will result if

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Perfect alignment is always maintained in this knife blade assembly with links centered in casing. The links are quickly and easily replaced or removed by loosening the nuts and slipping in or out.

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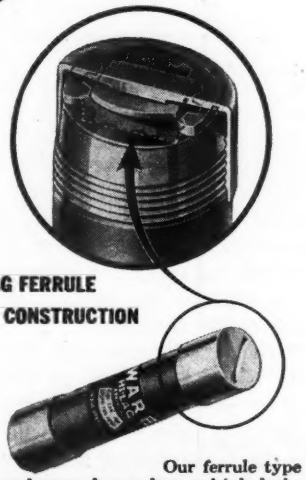

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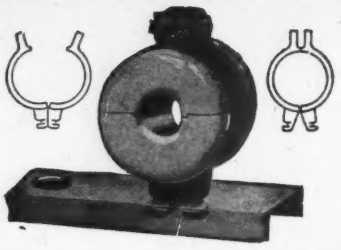

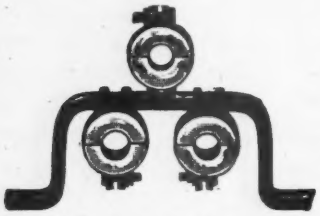

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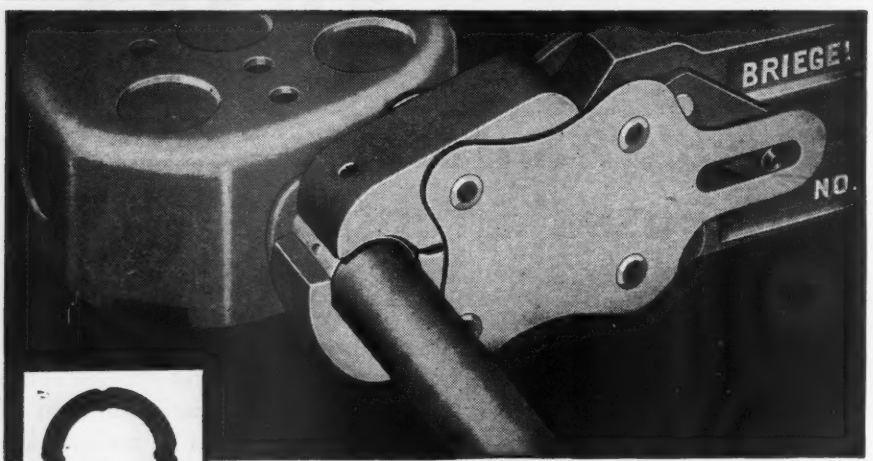

Cross section Showing Indentations.

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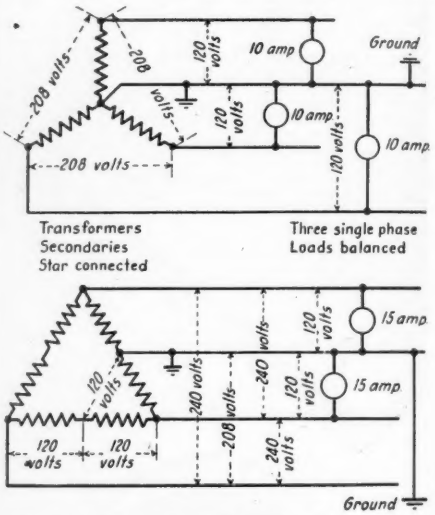
one load is disconnected and the neutral is then interrupted.—J.E.W.

A. TO QUESTION 221—As the question is stated, the former answer is correct. There is no current in the neutral and lamps will not dim if it is disconnected. From the statements that follow, I suspect L. G. D. may have balanced the lights in two groups and connected them one each between the neutral and each of two phases. In this case, the neutral will carry a current and the lights will dim if it is opened. He should divide the lights in three equal groups and connect them one each between the neutral and each of the three phase wires. Then, as long as the groups are balanced, no current will flow in the neutral and lights will not dim if it is opened. However, the neutral must be maintained, without fuses, and should be grounded at the transformer and at each service to prevent high voltage and unbalanced voltage in cases of unbalanced load, and accidental contact with high voltage




wires. The above assumed the three phase four wire 120 v.—208 v. system, which is derived from a bank of three single phase transformers with secondaries connected in star and neutral taken from the common point. Of course, the transformers must be supplied by a three phase line and may have primaries either star or delta as the voltages and transformer ratios demand.

There is another three phase four wire system derived from two or three single phase transformers with secondaries connected in delta and the neutral taken from the mid point of the secondary of one of them. This system should be called three phase four wire delta 120 v. —240 v. Here lamp load should be divided into two groups and connected one each between the neutral and each of the two phase wires coming from the transformer which supplies the neutral. When these groups are balanced, no current will flow and lamps will not dim when it is opened. But it also must be

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*VARTEX* gives you all these qualities—easy-working flexibility at any temperature — great mechanical strength — high dielectric properties — and maximum resistance against oil, grease, acid, alkali, moisture, heat and abrasion.

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***Write Today for Samples and Prices***

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***... Built For Long Service!***

*KIRKWOOD* dependable *COMMUTATORS* insure against service failures. Engineered for accuracy—precision machined to bore and diameter —bars that won't throw—high grade mica—heat treated to reduce expansion and excess mica binder—*KIRKWOOD COMMUTATORS* will withstand the most severe changes of vibration, heat and speed.

Engineering skill and the finest production methods guarantee *KIRKWOOD* built-in quality.

Prompt shipment from stock can be made on commutators for refrigeration, commercial or vacuum cleaner motors, and automotive types.

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**THE PAINE COMPANY**

**2961 Carroll Ave. Chicago 12, Ill.**

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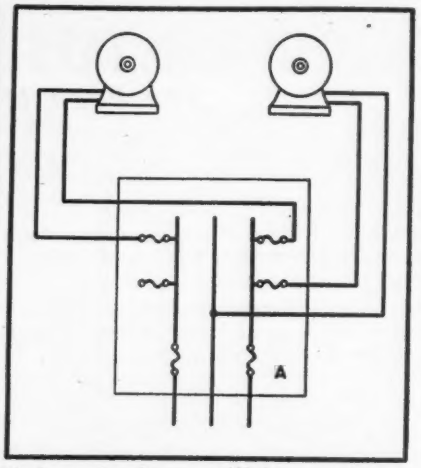
★ PAINE ★ FASTENING and HANGING DEVICES


maintained without fuses and should be grounded same as for the other system above. See diagram of each system with voltages shown.—C.H.A.

A. TO QUESTION 221—The neutral conductor will carry no current when a balanced load is supplied from a 4 wire, 120/208 volt circuit assuming equal voltages between phases. From the effect which was observed when the neutral was disconnected (two lights in series across 208 volts) it is evident that the neutral conductor is not being disconnected in a manner which leaves the neutral conductor from the various loads connected together at a common point. Further investigation will show that the neutral connection from the load connected to one phase has become isolated from the neutral connections to the loads connected to the other two phases when the neutral conductor is disconnected.—R.M.B.

## Can you ANSWER these QUESTIONS

**QUESTION A10**—We have two small motors connected, as shown, on a three wire 110-220 volt a-c line. Is either motor




likely to be damaged if fuse marked A. blows, leaving the two motors in series on the 110 v. line?—H.C.L.

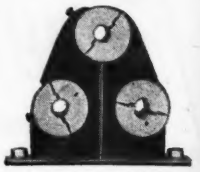
**QUESTION B10**—We have a 3-phase, one hp., 3600 rpm. motor which had burned out due to grounding. After the motor was rewound and then tested out, everything was all right with the exception that the motor took 3.6 amps., 3.6 amps., and 3.8 amps., respectively per each phase with no load operation which I believe was too high, as the nameplate showed 3.2 amps. for a full load.

What is wrong? The motor had 48 turns per coil, 24 slots, was connected parallel star, and was rewound the same as the old winding. Could a few turns short per coil be responsible?—E.J.K.

***PLEASE SEND IN YOUR ANSWERS BY AUGUST 15***


SIMPLICITY PLUS! New NON-INDUCTIVE CABLE RACK

for INDUSTRIAL PLANT WIRING



Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2¾".

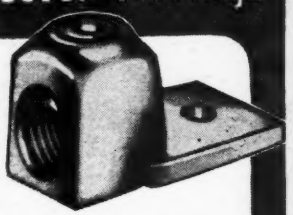
● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushing.

**Send today for Bulletin C-S-51 which illustrates the complete line**

**THE M. & W. ELECTRIC MANUFACTURING CO., INC.**

**EAST PALESTINE, OHIO**

Conductor Fittings



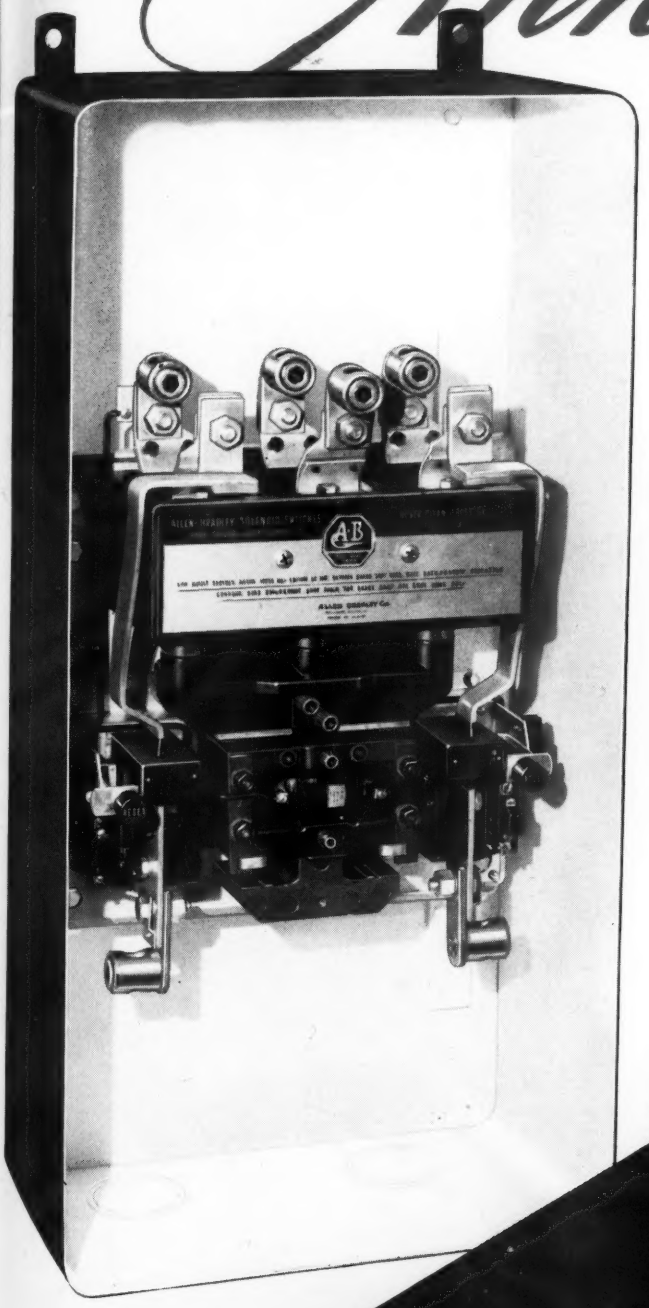
Penn-Union offers all good types of terminals: Solderless lugs to grip the conductor by Bolt, Screw, Post-and-Nut, or Multi-Slit Tapered Sleeve; Vi-tite, E-Z, Shrink fit, soldering lugs, etc.

Also Tee Connectors; Cable Taps; Straight, Elbow and Cross Connectors; Bus Supports; Grounding Clamps; Service Connectors, etc. *Penn-Union fittings are preferred by leading users* — because of their *Proven Dependability.*

**PENN-UNION ELECTRIC CORP. ERIE, PA.**

PENN-UNION

# *Announcing*



## the NEW SIZE 5

**(300 AMPERES)**

## Bulletin 709
## Across-the-Line
## *Solenoid Starter*

Allen-Bradley is proud to announce the development of another solenoid starter—the new Size 5. In this new 300-ampere switch, you get all the advantages of Allen-Bradley solenoid design—maintenance-free, double break, silver alloy contacts; simple solenoid construction; compact self-contained switch mechanism. Very possibly you have some Allen-Bradley solenoid starters doing a dandy job for you on your smaller motors. The new Bulletin 709, Size 5 is in the same class. It will give you the same satisfaction.

**MAXIMUM RATINGS:**

**50 hp, 110 volts**
**100 hp, 220 volts**
**200 hp, 440-550 volts**

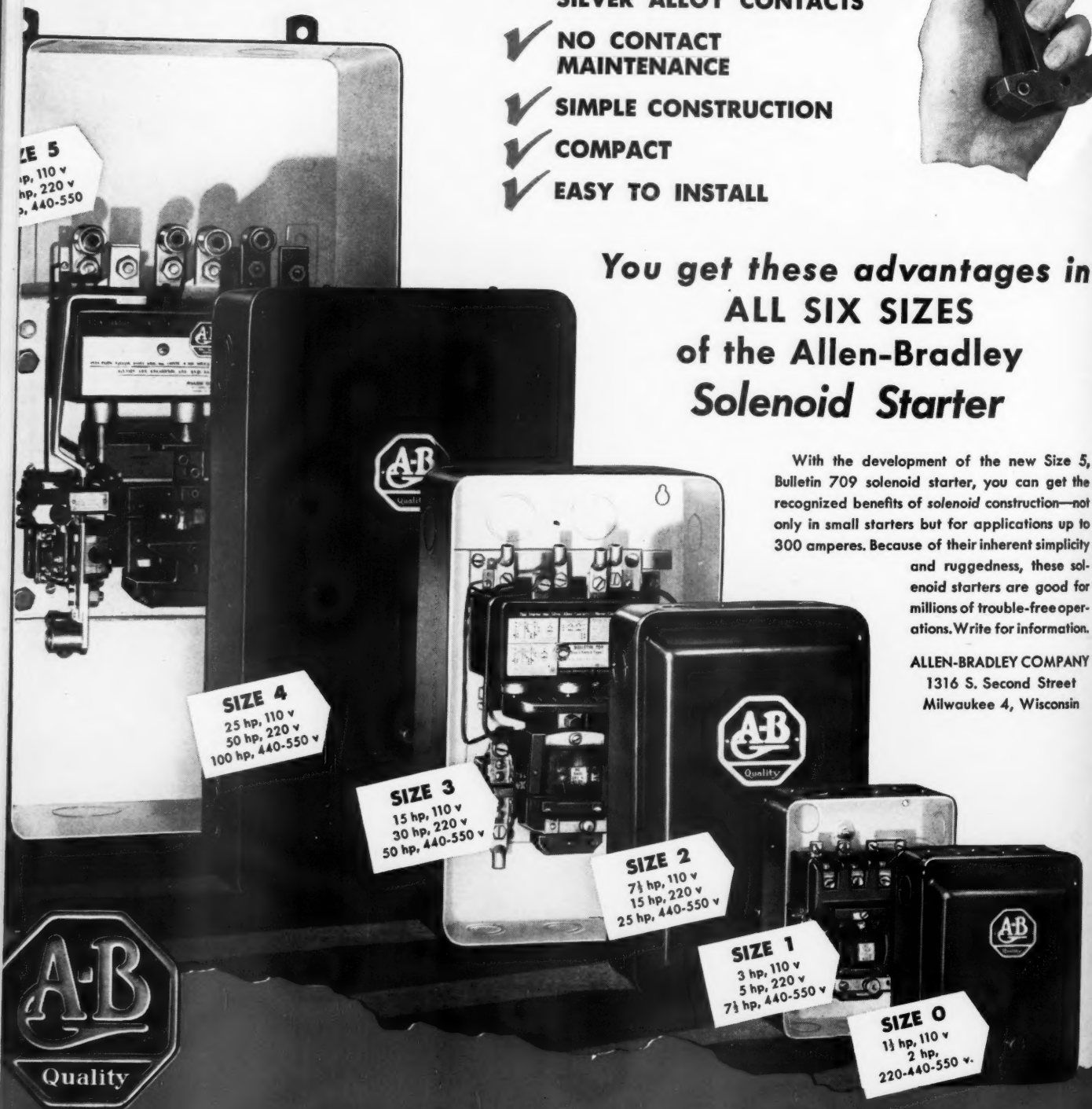
A-B Quality

# ALLEN-BRADLEY
## SOLENOID MOTOR CONTROL

QUALITY

# Only 1 Moving Part

- ✓ DOUBLE BREAK SILVER ALLOY CONTACTS
- ✓ NO CONTACT MAINTENANCE
- ✓ SIMPLE CONSTRUCTION
- ✓ COMPACT
- ✓ EASY TO INSTALL




## *You get these advantages in* ALL SIX SIZES of the Allen-Bradley *Solenoid Starter*

With the development of the new Size 5, Bulletin 709 solenoid starter, you can get the recognized benefits of *solenoid* construction—not only in small starters but for applications up to 300 amperes. Because of their inherent simplicity and ruggedness, these solenoid starters are good for millions of trouble-free operations. Write for information.


ALLEN-BRADLEY COMPANY
1316 S. Second Street
Milwaukee 4, Wisconsin


# ALLEN-BRADLEY
## SOLENOID MOTOR CONTROL

QUALITY

# Motor Shops

## EMERGENCY DRIER WITH DESIGN MERIT

Ingenuity is reflected in the design of an emergency infra-red drier made and used by the Evans Motor Repair Shop, Utica, N. Y. It is portable, flexible, and inexpensive. It is also easily made—from materials which every shop has on hand.

This simple homemade drier is the product of necessity in meeting an emergency. The necessity was brought about during the war when new bake ovens were unobtainable, even with high priorities. The emergency was caused when the Evans shop opened late in 1944 in order to help keep motors in repair and operation in Utica's war plants. T. T. Evans, owner, found it next to impossible to obtain the necessary machines and equipment needed to outfit his shop adequately. His small bake oven would not handle all the work he could turn out, so he supplemented it with the portable outfit shown in the accompanying photograph.

This emergency drier is made up of two free-standing wood frames, on each of which four 250-watt infra-red lamps are installed. Standard outlet boxes and box cover receptacles were used, each outlet box being made adjustable as to position by bolting the box to a board containing a groove along its center. These boards which hold the outlet boxes are also adjustable as to position on the wood framework, permitting the boards to be spaced close together or apart, as required. The frames were fastened to two pieces of 2 by 6, each 15 inches long, which held the frames upright. Since each frame is portable, and can be moved in and out, placed parallel to each other or at an angle, and since the lamps on each frame can be positioned as close together as six inches, or as far apart as two feet, this arrangement permits complete flexibility for obtaining just the right amount of heat where required for any drying operation.

Recognized as an emergency rig only, this idea has merit, especially where a drying operation "on the spot" is necessary, such as in getting motors into operation after a flood, or in similar cases.

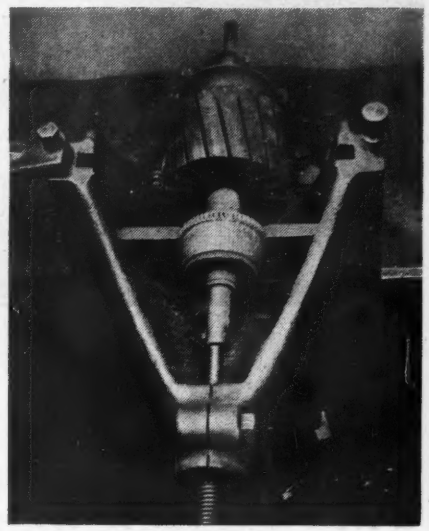


***FIG. 1—First step in use of "commutator puller" is to place armature shaft on bottom back-plate and align with the pressure screw.***

## SMALL COMMUTATORS REMOVED IN A JIFFY

Removing the commutators on fractional horsepower motors is no chore at all in the repair shop of Mears Electric Company, Wichita, Kansas. For years they have been using a horizontal type screw press which they call a small commutator puller. Bolted to the workbench in the small motor department, the device takes up little more space than an over-sized machinists vise.

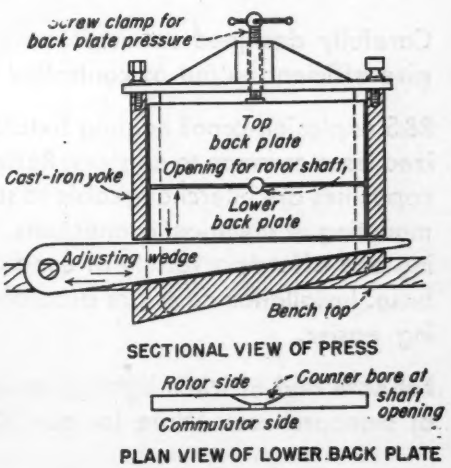
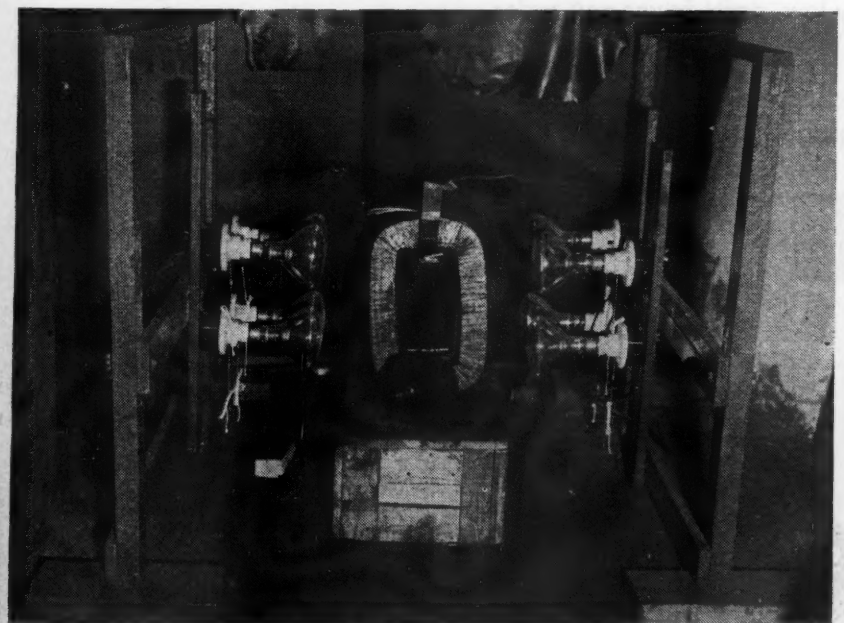



***FIG. 2—Sectional view of press illustrates how shaft alignment is accomplished with adjusting wedge and positioning maintained by tightening top screw clamp on back plates.***

The press works on the vise principle. Basically, it consists of a cast-iron yoke with a pressure screw at the top and grooves to accommodate sliding backplates (top and bottom halves) near the base (See Fig. 1). These plates, made of case hardened steel to withstand the pressure involved, are 8-inches long, 2½-inches high, and ½-inch thick.

Rotors are placed in the press in a



***The emergency infra-red drier shown here was made and used by Evans Motor Repair Shop, Utica, N. Y. It is simple to make, yet embodies excellent design for flexibility of application.***

# LIGHTING FIXTURES

**40 Years of actual service has proven the "know-how" of RUSSELL & STOLL in the field of vaportight and explosion-proof lighting.**

**R&S design and precision manufacture not only meet, but surpass Underwriters' and NEMA requirements. Rigid factory controls insure continuous, safe operation with minimum cost of maintenance.**

**Carefully designed reflector contours with high reflection factor give efficient output of controlled illumination.**

**R&S explosion-proof lighting fixtures are supplied with a standardized base common to all sizes. Reflector globe assemblies of various capacities are interchangeable to suit conditions. No need to disturb mounting or electrical connections. Modern design simplifies mounting and affords a variety of conduit arrangements in one standard base. Installation costs are accordingly low, parts fewer and ordering easier.**

**For safe and efficient lighting equipment specify R&S extra quality at standard cost. Write for our 300-page catalog.**

*Since 1902*

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RUSSELL & STOLL COMPANY

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125 BARCLAY STREET · NEW YORK 7, N. Y.

horizontal position with the shaft resting on the semi-circular opening of the bottom plate and so positioned that the back of the commutator presses firmly against the front (flat side) of the plate (the other side being counter-bored at the shaft opening). Alignment of the rotor shaft with the pressure screw is accomplished by sliding the adjusting wedge (see Fig. 2) in or out to raise or lower the bottom plate.

Once alignment is completed, the top plate is inserted in the grooves of the yoke and the top screw clamp closed and adjusted so the rotor shaft is firmly positioned between the two plates. The rotor end of the shaft rests on blocks to prevent swaying. When the lever arm of the pressure screw is rotated (see Fig. 3), the rotor shaft is pushed inward while the back plates hold the commutator assembly stationary. The resultant action is one of "pulling" the commutator off the shaft without damage to armature or shaft.

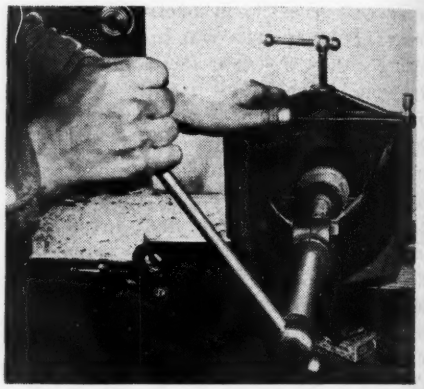
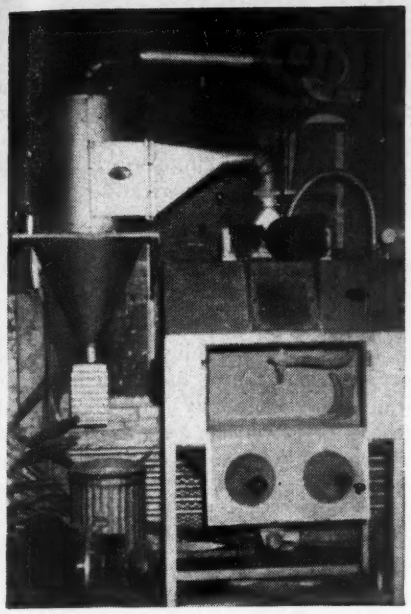


***FIG. 3—Complete setup of commutator puller showing mechanic about to rotate pressure screw which forces armature shaft back and commutator forward. Device saves considerable time in the busy motor repair shop.***

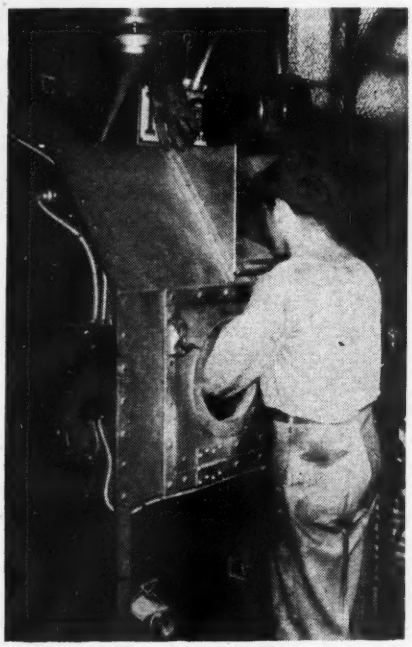
According to George A. Moore of the Mears company, the device can be used for armatures up to about one horsepower in size and commutators measuring five inches (maximum) in diameter. It is particularly useful for automotive armatures, but saves considerable time when all types of commutators (within the limits mentioned) are to be removed.

## SAND BLAST CLEANS AND POLISHES

A compact, fully enclosed sand blaster is extensively used in the shop of the Electric Service Repair Company, Paterson, N. J., for cleaning and polishing a wide variety of metal parts ranging in size from contacts to stator frames. Operation is rapid and results are effective with this equipment manufactured in Chicago by the Mott Sand Blast Company.



***Sand blast cabinet with opened front section shows blast nozzle, eye-level vision panel, conical rubber arm guards, exhaust system and sand-salvaging baffled drum.***



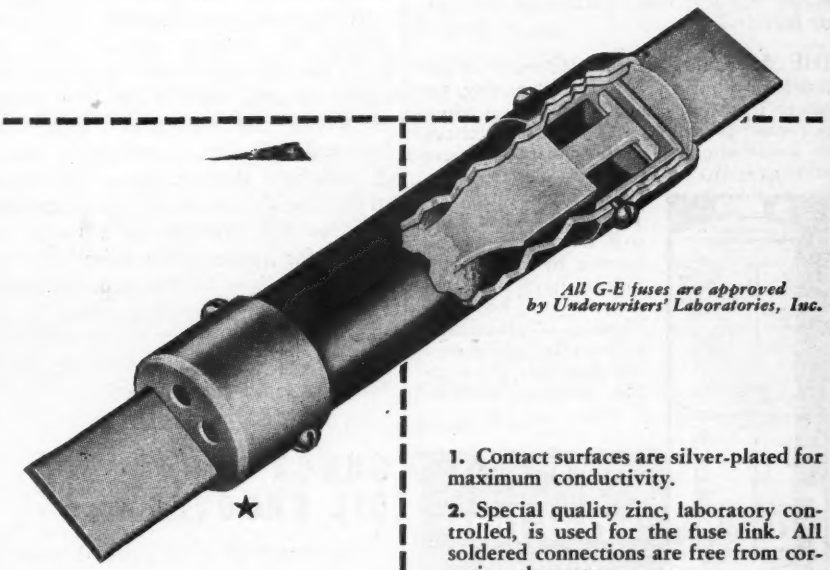
***Operator inserts arms through truncated rubber cones to hold work or direct blast stream. Close supervision is possible by looking through vision panel and regulating blast pressure through foot lever. Switches for exhaust system and interior cabinet lighting appear at operator's left.***

The sanding cabinet has a cam-fastened bottom-hinged drop front, pierced by two circular openings through which the operator can insert his arms in order to hold and rotate the metal part being polished or to direct the flexible-connected sand-blast nozzle. Truncated rubber cones, with their base circumferences, fastened to the peripheries of these openings in the cabinet front, fit snugly around the operator's wrists and prevent whirling sand from leaving the


# 8 good reasons

## WHY G-E SILVEND* FUSES

## provide lasting protection for electric equipment



*All G-E fuses are approved by Underwriters' Laboratories, Inc.*

G-E Silvend fuses are especially desirable for use in industrial plants where reduction of maintenance time is important.

The silver-plated contact surfaces of G-E Silvend fuses maintain good electrical contact as long as the fuses stay in service. There is no heating due to oxidation to cause premature blowing.

G-E Silvend fuses are particularly suited for use with apparatus having silver-plated fuse clips. They will, however, give better service than ordinary fuses where brass or copper clips are used.

For further information, get in touch with your local G-E Merchandise Distributor, or write Section D9-7-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

**Trade-mark Reg. U.S. Pat. Off.*

**1.** Contact surfaces are silver-plated for maximum conductivity.

**2.** Special quality zinc, laboratory controlled, is used for the fuse link. All soldered connections are free from corrosive elements.

**3.** The filler is made under laboratory controlled conditions of temperature and humidity. It has proper texture and does not cake.

**4.** The casings are accurately gaged to assure tight fit. Amperage ratings are stamped on enclosure.

**5.** Casing is of moisture-resistant, treated fibrous material.

**6.** Caps for ferrule-type fuses (3-60 amp) are crimped and staked to the casing. On blade-type fuses (61-600 amp), caps are securely bolted to a steel support or yoke inside the casing.

**7.** This yoke prevents fuse blades from twisting, and assures proper contact alignment.

**8.** All G-E fuses are accurately calibrated under laboratory supervision to pre-determined characteristics. Exclusive G-E tests assure maximum standards of fuse performance.

GENERAL ELECTRIC

**Sav-U-time**

**"TOUCH BUTTON" *Control for***

**GAS WATER HEATERS**

**THE PRODUCT:** Sav-U-time provides push button control for side arm gas water heaters, from bathroom, kitchen or laundry.

**THE ADVANTAGES:** Hot water at the touch of a button. No stair climbing, no match lighting. Heater only in use when hot water is needed. All the conveniences of automatic hot water heat with gas savings up to 50%.

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**THE PRICE:** You sell Sav-U-time for $39.50 plus a small installation charge—with 100% profit for you. It's a price that every home can afford.

**IMMEDIATE DELIVERY:** Here is a wanted item that you sell, deliver, and collect your profit now.

**DEALERSHIPS AVAILABLE:** Cut yourself in on this profitable business. Take a tip from dealers in St. Louis, Detroit, Philadelphia—who are cleaning up with Sav-U-time. Many territories still open. National advertising, dealer helps back you up. Write or wire for details *NOW*.

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**74 Manhattan St., Rochester 2, N. Y.**


enclosed working area. The hands of the operator are protected with rubber gauntlets. A glass vision panel at normal eye level permits vision into the chamber while the work is illuminated by lights located inside the cabinet.

An inverted pyramidal hopper beneath the blast area holds the finely pulverized sand which is used in the cleaning processes. A metal screen separates the main cabinet and the hopper, allowing sand to fall through but preventing the passage of parts being treated. Sand is drawn from the bottom of the hopper into the blast nozzle through the suction action created by pressure-regulated compressed air entering the twining nozzle connection. Control of the air pressure and the resultant sand blast action is regulated by a cantilevered foot pedal.

A high capacity suction fan located above the cabinet removes the dust from the chamber while suspended particles of sand, sucked into the exhaust air stream, are trapped in a baffle chamber and fall into a salvaging hopper. A weighted leather flap at the bottom of this conical funnel allows accumulated sand to fall through to a metal container for reuse while effectively confining the dust to the exhaust system. Control of the exhaust fan and the cabinet interior lighting is by means of switches conveniently located on the side panels of the cabinet.

## CHUCK FOR OIL GROOVES

"A pretty good all around machinist laughed when I showed him this one," said J. O. Homm, owner of the Service Electric Co., Huntington Park, Calif. "He said he couldn't see why he had not thought of it before.

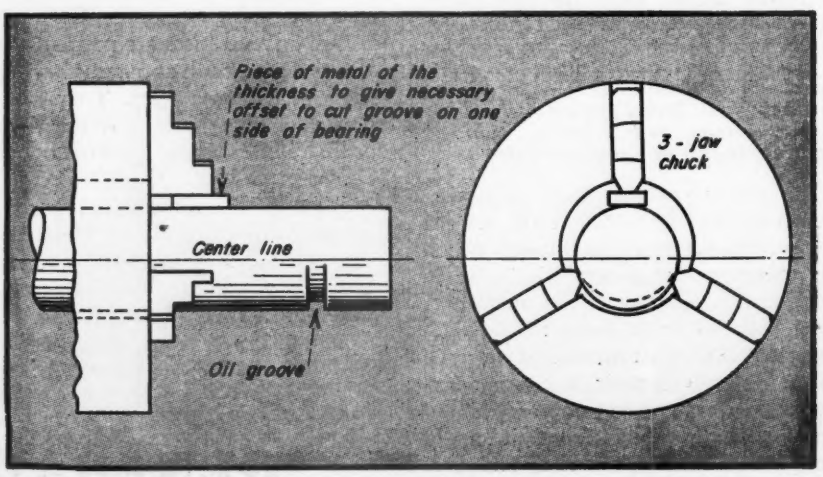
"I had told him to cut an oil groove on one side of a bearing and he had started to take out the 3-jaw chuck and replace it by a 4-jaw, in order to set the bearing off-center. I told him to leave the 3-jaw in and showed him how, by inserting a piece of metal between one jaw and the bearing he could get the necessary eccentricity in much less time.

"Simple as it is, I find that a surprising number of machinists are not onto this little time-saving trick."

## CLEANING TANKS

Tanks, for cleaning dirt, oil and grease from motors and other electrical equipment, essentially consist of a tank where the motor being cleaned is placed, a drain reservoir into which solvent settles by gravity for filtering and storage, a pump for recirculating the filtered solvent and a hose and nozzle arrangement for carrying and directing the solvent against the motor. These tanks are generally recognized and employed by modern shop operators but individual variations and improvements recurrently suggest new, practical procedures. Cleaning tanks located in the Easton and Allentown, Pa., shops of the H. N. Crowder, Jr. Company combine several ideas for improving the safety, efficiency, cleanliness and speed of cleaning routines.

Compressed air is available at the Crowder booths for more effective cleaning and drying. Two hose carry air under pressures ranging up to 80 pounds. One hose is twined to the nozzle emitting the filtered solvent and, mixing with the solvent through whirlpool atomizing action, the air carries the cleaning fluid to the motor in a high powered, penetrating spray. The construction of the nozzle is such that the rush of air pulls the solvent from the reservoir in much the same manner that a hydraulic ejection pump removes water from a sump. Compressed air, therefore, increases the velocity, force and effectiveness of the cleaning stream and also eliminates the necessity for employing the usual, independent pumping mechanism. The other hose carries dry air


Piece of metal of the thickness to give necessary offset to cut groove on one side of bearing
3 - jaw chuck
Center line
Oil groove

***Eccentricity of three-jaw chuck accomplished by metal shim.***



and is directed through a second nozzle

# THE COMPLETE LINE FOR THOS... INDUSTRIAL EXPANSION JOBS...

**There's a lot of remodeling and industrial expansion going on in every section of the United States—that means there's a lot of new wiring and rewiring to be done right in your territory.**

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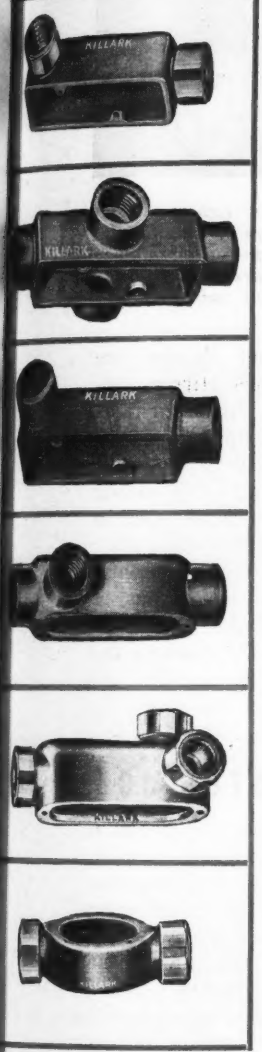
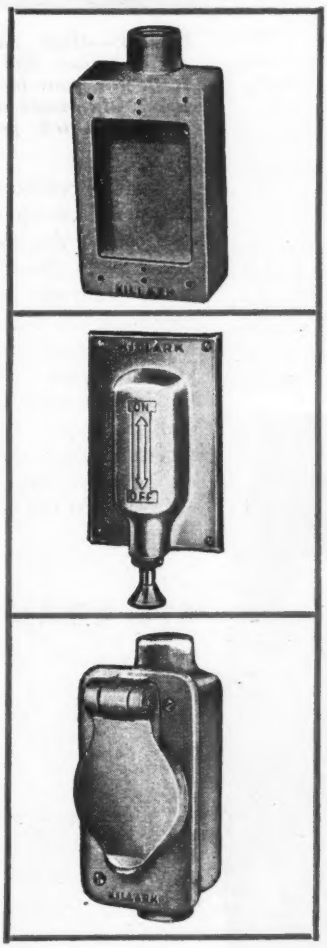


## FLUSH SWITCH FITTINGS



With the complete Killark line you will be sure to have the proper fitting for every junction, outlet, switch and light—from the entrance cable—throughout the entire job.

Whether the wiring job calls for thinwall or standard conduit—you'll have exactly the right fitting in Killark threaded or threadless types—in oval and rectangular conduit bodies.

The job will be done faster and better with the *complete* Killark Line—on all exterior and interior installations. The Killark Line has all types of Vaporproof fittings for exteriors and for interior installations subject to dampness.

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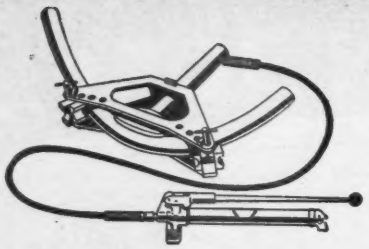

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COMPANY_____

ADDRESS_____


and is directed through a second nozzle for blowing dust and loose dirt from the motor before cleaning, dislodging local grease clods loosened by the solvent and drying the motor after the cleaning operation is completed.

A high capacity exhaust fan, mounted in the tank hood, removes odors, vapors and spray from the booth and the immediately surrounding area. Another preventive against air-borne hazards is the front metal panel which slides vertically between grooves in the tank housing. The panel can be instantly lowered to localize a possible fire in the tank or to seal the booth from the shop when cleaning is not in progress. The possibility of fire becomes remote when a non-inflammable solvent is used but vaporized oils and greases, while non-explosive, remain as a potential combustion danger and should be considered when designing the booth.

Fig. 1, in addition to illustrating the double use of compressed air and the sliding metal front panel, indicates the application of a turntable for supporting the motor. This freely-revolving, ball-bearing, round steel plate platform can be turned either by nudging it with the hose nozzle or by directing the air pressure against one side of the motor.

Fig. 2 shows the overhead exhaust flue leading from the hood and also illustrates a method for directing illumination into the working space without utilizing explosion-proof fixtures located inside the tank enclosure. Several

***FIG. 1—Air under pressure combines with solvent in a siamese nozzle and increases the spray force while eliminating the necessity of a circulating pump. A turntable permits rotation of the motor without manual contact. The sliding front metal panel seals booth from shop during periods between cleanings.***

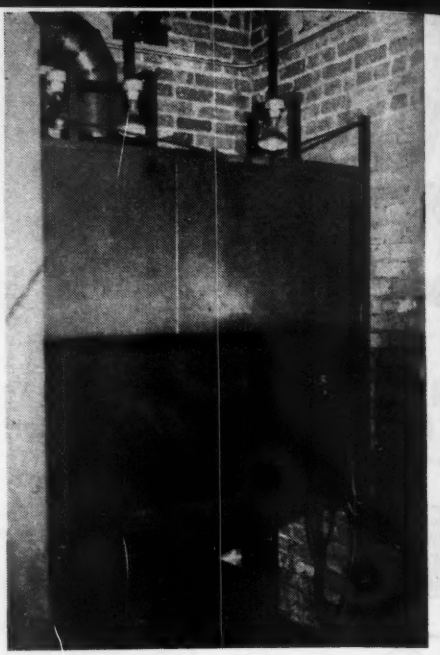


***FIG. 2—High capacity exhaust fan draws vapor and odors from hood. Reflector spot lamps, mounted above hood, illuminate work area by shining through thick panel of wired plate glass.***

250-watt reflector spot lamps are mounted base-up on steel stirrup supports above the hood. A panel of thick wired plate glass extending across the hood, separates the fixtures from the vapors inside the enclosure. Mounting the glass panel on a slight angle tends to keep the glass comparatively clear since the incline permits the rising and condensing vapor to form into drops of moisture which slowly trickle to one side of the hood and down the sides of the enclosure to the reservoir.

## BIG COMMUTATOR JOB

An unusual job tackled by Ets-Hokin & Galvan, San Francisco, was to rebuild, rewind, and completely remica the armatures of this 750 hp. double armature motor. This motor was one salvaged from an oil tanker that had lain sunken in salt water for many months. After the job was done, the armature was put in a lathe and the commutator turned down.

Alexander Balog who did all the work on the two commutators, each almost 4 ft. in diameter, is shown here soldering commutator risers. To space the risers so that they will make contact with their respective leads, wood wedges are driven between the risers, a slow and painstaking job, done so that perfect electrical contact is made, even without any soldering. The soldering is done afterwards to make this contact doubly sure, but largely serving to keep out dust and dirt.

In doing this work, Balog made him-

# YOU'RE ON THE RIGHT TRACK...

## WITH U.S. SECURITY

● **Why? Because Security does the job better. It's highly dielectric, non-ravelling, straight-tearing, highly insulating and has strong adhesion.**

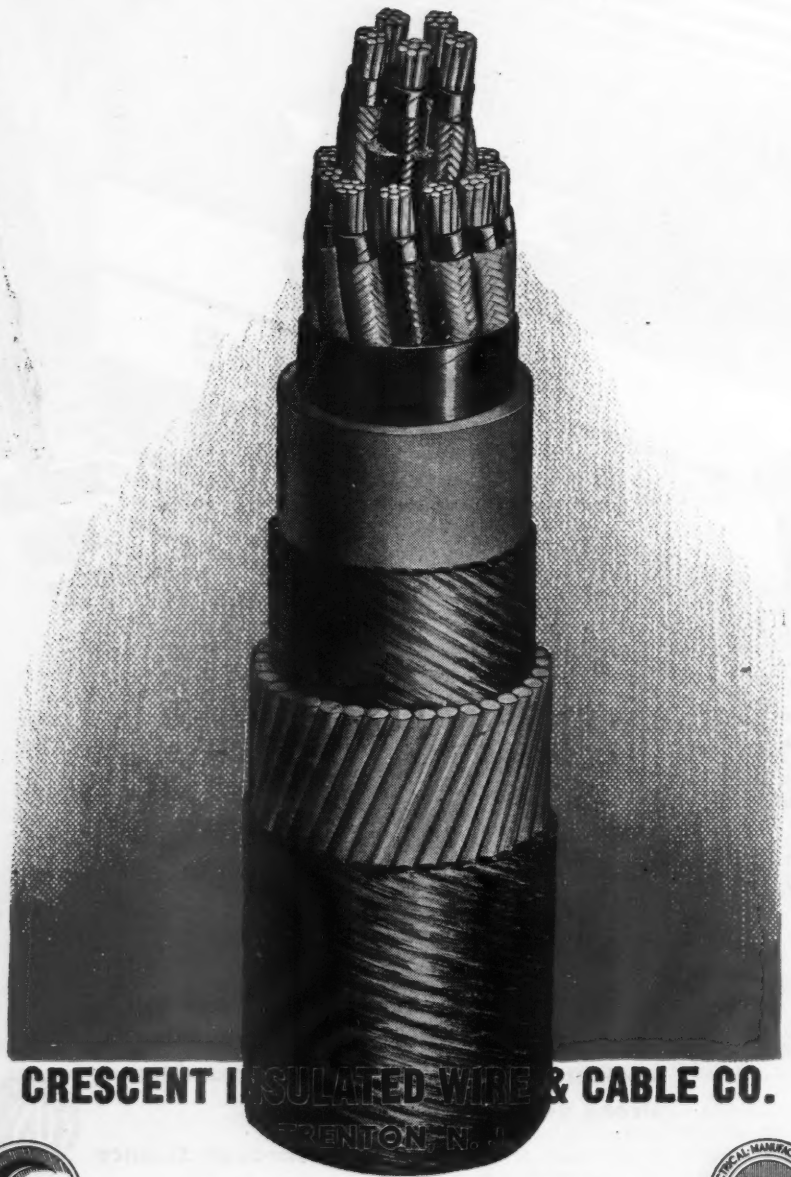
*Serving Through Science*

## UNITED STATES RUBBER COMPANY

**1230 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER • NEW YORK 20, NEW YORK**

# CRESCENT WIRES AND CABLES

## Serving Industry for More than Half a Century



CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

NEMA
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
MEMBER

***Soldering one of the sets of commutator risers on 750 h.p. double armature.***

self a set of special tools shaped somewhat like cold chisels. Making them out of spring steel insures their not breaking under hammer blows, prying and other operations to which they are applied.

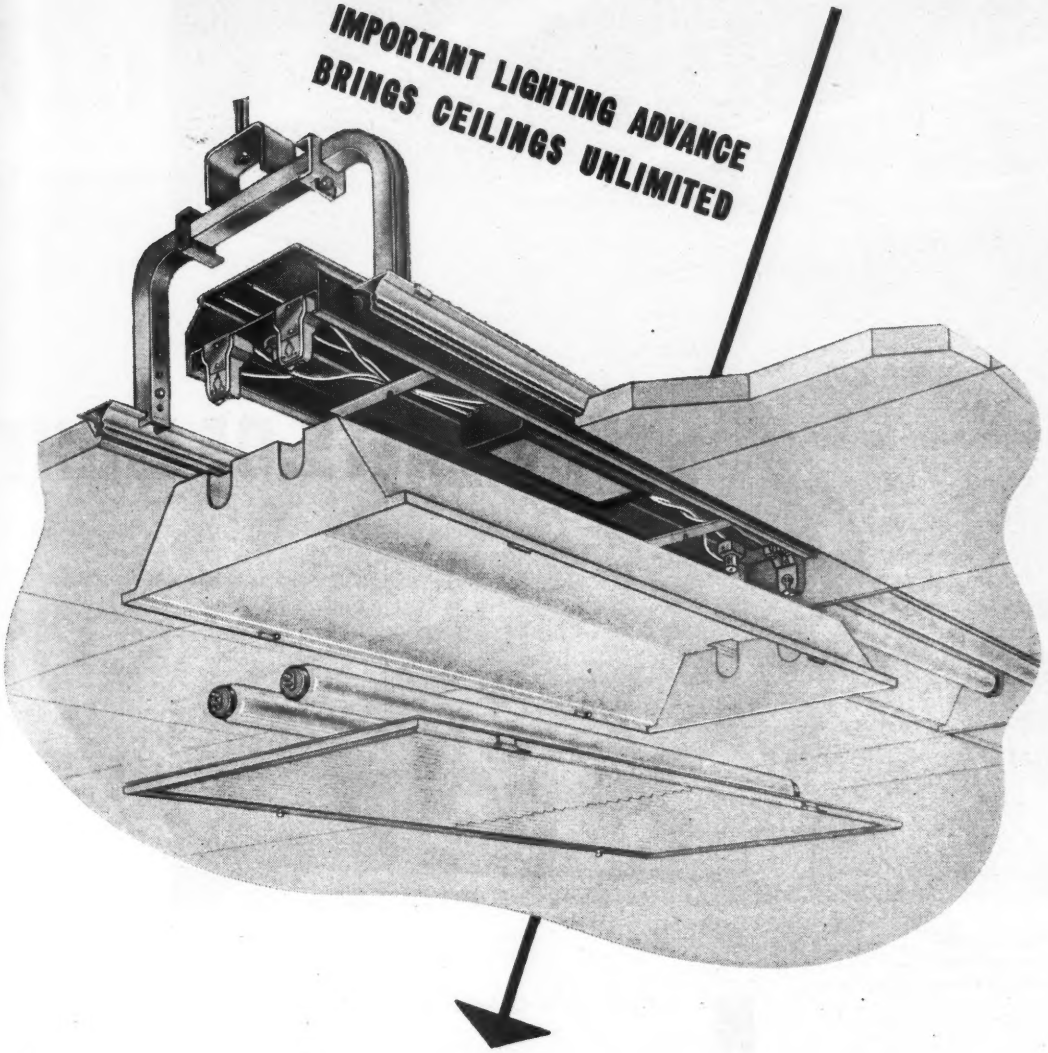
## VAPOR DISSOLVES GREASE

Oils, resins, pitch and greases are rapidly and thoroughly removed from motor parts when subjected to treatment in the hot vapor degreasing tank employed in the shop of the Electric Service Repair Company, Paterson, N. J.

The open-topped metal tank is equipped with a pre-set thermostat, located on the side of the tank, which controls both the temperature and level of the vapor solvent as well as activating the distilling unit. The non-inflammable, non-explosive solvent has a relatively high (1.6) specific gravity which makes the vapor level readily controllable and eliminates the possibility of overflow. Due to its chemical nature, the cleaning fluid is the most stable of all chlorinated solvents and can be reclaimed and redistilled without loss of its original properties. Vaporization is effected through an electric heating unit.

In operation, stator frames and other motor parts are lifted by a pivoting overhead monorail crane, swung into position above the tank and lowered into the vapor cloud. The hot (250 degrees F) vapor rapidly frees metal surfaces from clinging dirt and petroleum products. Vaporization is greatly accelerated on removing the metal parts, leaving the metal surfaces both clean and dry. Commercial units now available can effectively clean from 500 to 5,000 pounds of metal parts per hour, constantly reclaiming and redistilling from 5 to 25 gallons of cleaning fluid. The unit discussed is a Model DS 4836, 3,000 pound hourly capacity, Midwestern Vapor Degreaser.

# IMPORTANT LIGHTING ADVANCE BRINGS CEILINGS UNLIMITED



THE MILLER FLUORESCENT TROFFER LIGHTING SYSTEM — an important engineering achievement, makes it possible for stores, offices, schools, factories and public buildings to be planned around the lighting. Fixtures merely provide light but this complete lighting system provides light at the overall level desired, and in addition, it can be installed as single units, blocks, geometric patterns or light strips to form any ceiling pattern desired. CEILINGS UNLIMITED. Consider these economies — (1) the MILLER CEILING FURRING HANGER (patented) reduces number of supports needed from structural ceiling and simplifies installation; and (2) completely wired continuous channels (MILLER pioneered) reduce wiring costs, conduit and conduit fitting costs from 50% to 80%. MILLER field engineers are conveniently located to serve you.

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ILLUMINATING DIVISION, MERIDEN, CONNECTICUT

ILLUMINATING DIVISION — Fluorescent, Incandescent Mercury Lighting Equipment

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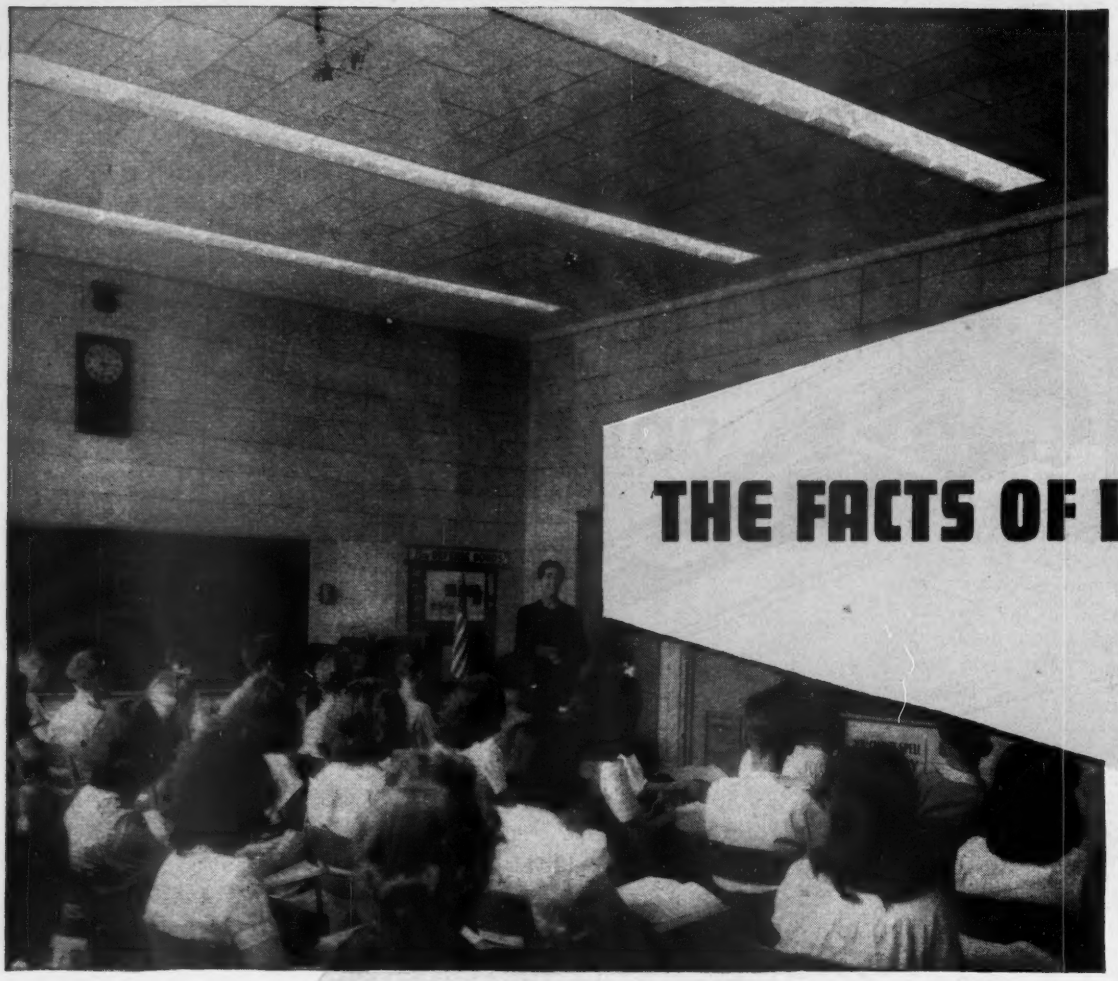
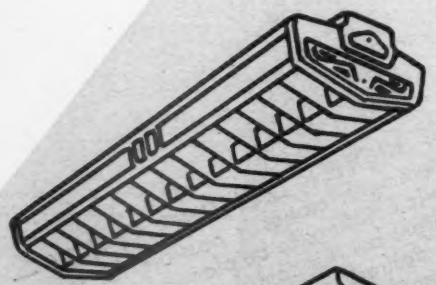


# THE FACTS OF LIGHT

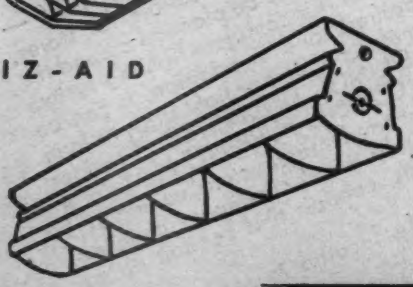
Alton, Illinois, High School—a model of engineered lighting achieved with Day-Brite recessed troffers.

No matter how carefully you engineer your lighting layouts, their success depends largely on the fixtures you specify. Certified distribution curves prove the efficiency of optically engineered Day-Brite fluorescent fixtures. They are skillfully designed for easy installation and maintenance. Quality construction in every detail makes them a dependable source of abundant, glareless illumination.

There is a Day-Brite fixture to meet every lighting need. Write us your requirements,



VIZ-AID



LITEWAY

**Day-Brite Lighting, Inc., 5401 Bulwer Avenue, St. Louis 7, Mo.**
**Nationally distributed through leading electrical supply houses.**
***In Canada:* address inquiries to Amalgamated Electric Corporation, Ltd., Toronto 6, Ontario.**

1051 A

IT'S EASY TO SEE WHEN IT'S

**DAY-BRITE** *Lighting*

# Modern Lighting

## INCANDESCENTS USED IN JEWELRY STORE

The new Howard Street Jewelers store, which managed to open its doors to Baltimoreans in time for the 1945 Christmas rush, used incandescent units to provide quality general lighting. Wall cases were lighted with fluorescent, using 3500° white lamps. The lighting equipment was installed by Wm. G. Stockhausen, electrical contractor, who also planned the lighting in cooperation with H. M. White, illuminating engineer with the Consolidated Gas Electric Light and Power Company of Baltimore.

High intensity show window lighting of over 200 footcandles attracts both pedestrians and motor traffic to the store. Concentrated reflector spot lamps of 300 watt size are installed on one-foot centers close to the plate glass, and 200 watt concentrated type silver mirrored glass reflectors on 18 inch centers near the back of the windows, to obtain this high level display lighting. Both types of units are recessed flush in the ceiling, and louvers are used with the reflectors in the rear part of the windows to shield the lamps from window shoppers.

General illumination within the store ranges from 50 to 60 footcandles on top of the show cases. The lighting result is geared to modern "light for selling" practice. Approximately three-fourths of the light intensity is direct lighting from extensive type distribution silver mirrored glass reflectors equipped with 200 watt incandescent lamps. These reflectors contain concentric louvers to shield the lamps and prevent glare, and are recessed flush in the ceiling. They are spaced on six foot centers, and installed directly over the front edge of the floor cases. The direct lighting from these units creates the desired sparkle in the merchandise—jewelry, watches, silverware, and similar items.

Additional illumination is indirect, and is obtained from six 500 watt totally indirect suspended luminaires installed down the center of the store. These units light the ceiling uniformly, and create a pleasing atmosphere throughout the store. Side wall cases are individually lighted with fluorescent lamps concealed in the top of the cases. No show case lighting is used in floor cases, as these cases are well illuminated by the recessed overhead reflector units.

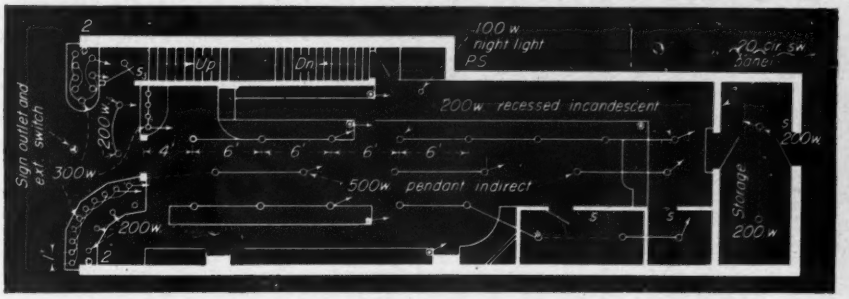



*FIG. 1—Floor plan and wiring layout for lighting in Howard Street Jewelers store, Baltimore, Md. Show windows use 7200 watts, and store interior uses 6200 watts for general lighting.*

*FIG. 2—Direct and indirect lighting are used to produce 50 to 60 footcandles of illumination in this Baltimore jewelry store. Sparkle and glitter are created by the direct lighting, and a cheerful atmosphere results from the indirect lighting. Highlights in wall cases are from fluorescent lamps.*

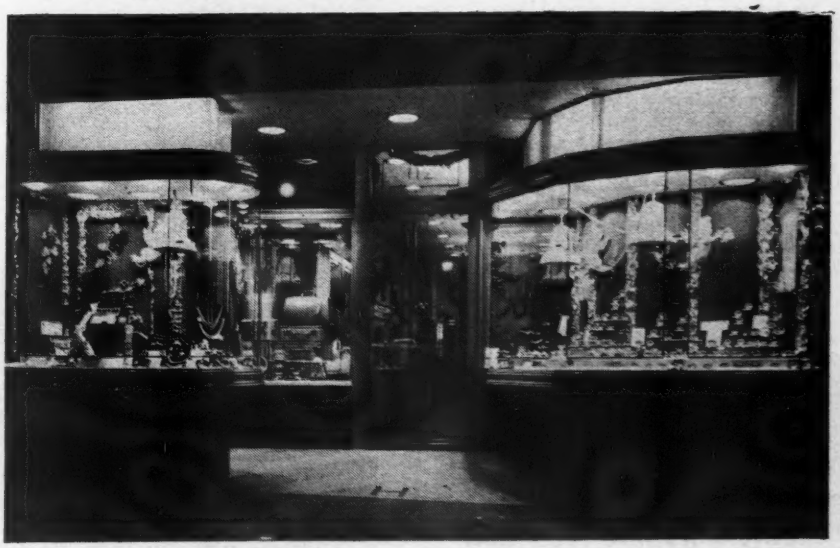


*FIG. 3—Reflector spot lamps, 300 watt size, are spaced on one foot centers to produce over 200 footcandles in show windows.*

McGILL

Safety Vaporproof GUARDS... with Tight-sealing Globes

UL Approved by Underwriters

Safeguard Life and Property

Where there is a possibility of fire, or other disaster from a spark, exposed flame, heat or breaking of bulbs, then McGill Vaporproof Lamp Guards should be used on all portable or extension lights. The tight-sealing globe and heavy cage, with air-tight seal in handle opening, eliminate these hazards at every spot where this guard is used. These Vaporproof guards are designed to stand up under roughest use and abuse.

These guards also protect the light bulb and prevent breakage when used around machines where water and oil might splash on the bulb. Guards also are grounded — an additional safety feature.

McGILL MANUFACTURING CO., INC.
*Electrical Division*
VALPARAISO, INDIANA

# LIGHTING PROSPECTS CHOOSE INTENSITY

The need for high level illumination can be demonstrated. Correct spacing of fluorescent fixtures, as well as incorrect, can also be demonstrated.

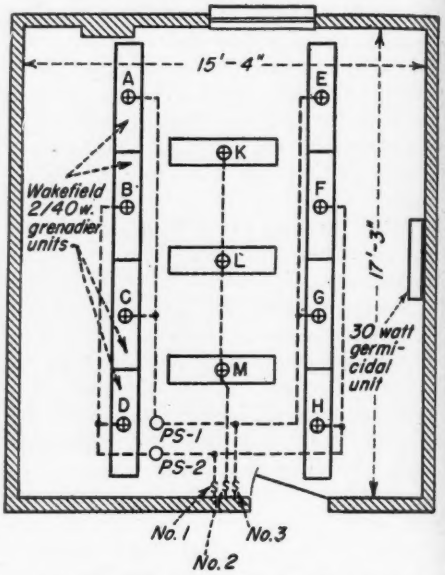
Lighting in a typical private office has been planned to accomplish these results. The accompanying plan shows the lighting layout used. The layout was designed by Walter C. Shulz, Warren Division, Ohio Public Service Company for one of the offices of that company.

The office is 15 ft. 4 inches wide, 17 ft. 3 inches long, and the ceiling height is 11 ft. 6 inches. The ceiling is finished flat white; side walls are finished in Nela green. Eleven Wakefield "Grenadier" units are used in the lighting layout. Each unit is equipped with two 40 watt 3500° white fluorescent lamps, located as shown on the plan. The office contains a table, located in the center of the room, and a desk, located against one of the long side walls, as shown in the photograph.

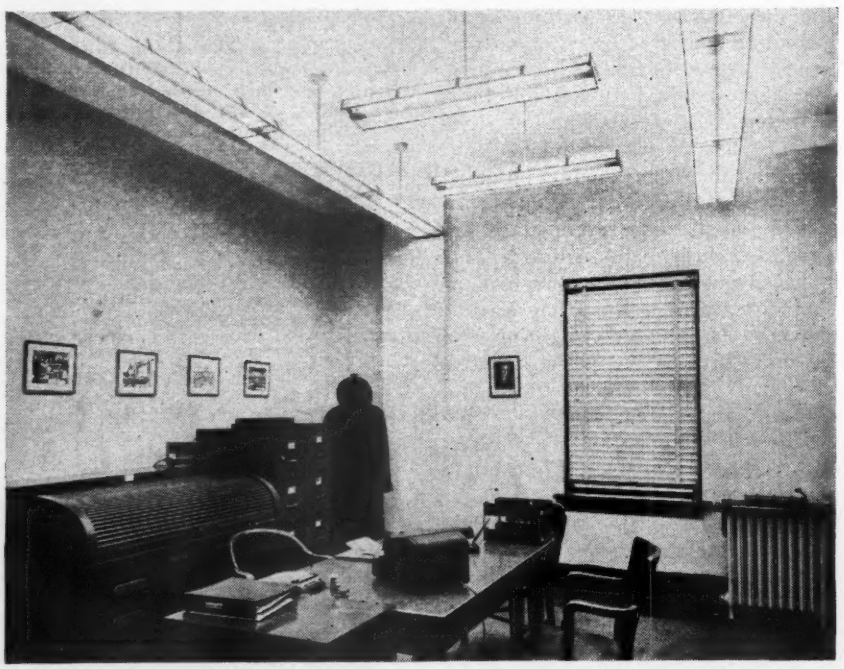
Three wall switches are used to control the eleven fluorescent units. One wall switch controls the first and third units of each side row of fixtures; the second switch controls the second and fourth units of each side row of fixtures; and the third wall switch controls the three separate center units. Pull chain switch control is also used on the row of four units located along the wall side of the room over the desk. One pull chain switch controls the first and third units, while the other controls the second and fourth units. This flexibility in switching enables various intensities of illumination to be demonstrated, as shown in Table I. It also permits the effect of spacing on the quality of lighting to be demonstrated.

This demonstration room gives the prospective customer a chance to choose his own level of illumination for his office, store, school, drafting room, or other type of occupancy. Recommendations for 50 footcandles or higher are usually approved, after a demonstration. The office provides a place of quiet where both the customer and the salesman can concentrate on the customer's specific lighting problems without interruption.

Demonstrations are made by placing




***Plan showing planned lighting layout and details of switching to provide range of lighting intensities.***

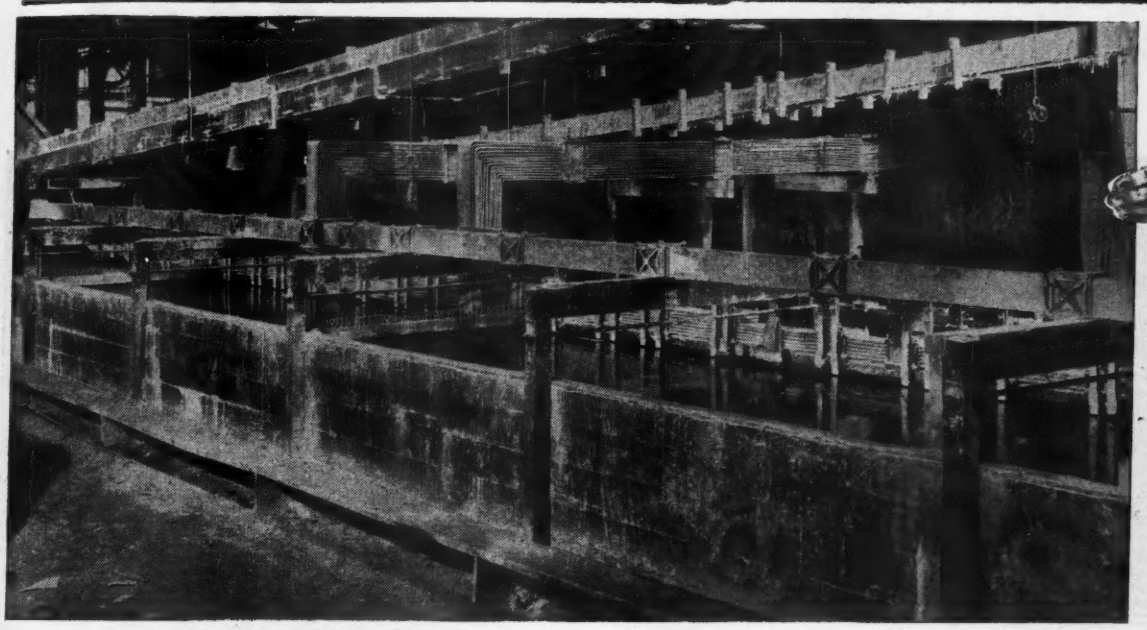


***Private office in Ohio Public Service Company, Warren Division, is used as demonstration room to demonstrate varying intensities of illumination to lighting prospects.***

# Alcoa Aluminum Bus Bars

***have everything the electroplater needs...***

- **HIGH CONDUCTIVITY**
- **LIGHT WEIGHT**
- **RESISTANCE TO CORROSION**
- **PROMPT SHIPMENT**



Plating room installations offer many problems, but not for Alcoa Aluminum. On the job illustrated, the Alcoa Aluminum Bus is employed for electrogalvanizing . . . using zinc sulphate bath. It was installed in 1930 and is still giving dependable, trouble-free service.

Ability to withstand corrosive attack is a characteristic of Alcoa Aluminum which is all-important in electroplating installations. In addition, the high conductivity-weight ratio of aluminum bus, ease of erection and low cost show over-all economy.

Alcoa Aluminum can be furnished in all the shapes you need—flat bars, tubes, channels and angles. Many sizes are available for shipment from stock. For information and prices, call the nearby Alcoa office, or write ALUMINUM COMPANY OF AMERICA, 2197 Gulf Building, Pittsburgh 19, Pennsylvania.

**ALCOA ALUMINUM**

IN EVERY COMMERCIAL FORM

# HERE'S NEW for

**4 Fact-Packed Meetings show how to capitalize on Modern Sales Lighting**

**OPENING MEETING:** Why should the Electrical Contractor aggressively go after the Store Lighting Business?

**SECOND MEETING:** What is Sales Lighting? New Lamps and Fixtures for the Storeowner. Movie: "The Magic of Fluorescence." The 3 A's of Store Lighting.

**THIRD MEETING:** How to Specify, Maintain and Finance Sales Lighting. A Practical Lighting Maintenance Service.

**FINAL MEETING:** How To Sell Sales Lighting. Why the Storeowner Buys: Demonstrations. How to use LaSalle Sales Training.

# HELP contractors

## G-E COORDINATED STORE LIGHTING PROGRAM READY NOW!

HERE'S a powerful force to help you find, develop and close more profitable sales of commercial lighting. It's a broad, inclusive, fast-moving program developed by General Electric to help you cash in on the tremendous store lighting business that exists NOW.

Key to the new program is a complete series of four local meetings packed with ready-to-use, up-to-date tools and technics that give you all the facts on:

1. How best to locate and develop prospects and meet their individual needs using modern lighting tools, and

2. Proved ways to get more and better profits from lighting jobs and realize your share of today's huge store lighting market.

Each meeting—featuring movies, sound-slide films, charts, skits and dozens of other war-proved methods of making graphic and convincing demonstrations—will prove how lighting can best be specified, sold and installed; how costs can be minimized; short-cuts to more and better lighting profits; and a wide range of new and improved sales practices.

**DON'T DELAY.** Call your G-E Lamp Representative for full information about the G-E Coordinated Store Lighting Program. It's the most complete, most practical program of its kind ever offered... call today.

**GET ALL THE FACTS** about the G-E Coordinated Sales Lighting Program for Contractors. Don't delay. Call your nearby G-E Lamp Representative for booklet that gives full details.

# The New Home of Lloyd PRODUCTS

Lloyd appreciates the patience and forbearance you have shown when overloaded manufacturing facilities slowed down delivery of Lloyd Flex-Loc Lamp Holders and Lloyd Automatic Starters. We are now at home in this large modern plant, where greatly increased facilities will make possible greater service to all our customers . . service which we hope will match in quality the matchless Flex-Loc Lamp Holders and Lloyd Automatic Starters.

**LLOYD POLICY INSURES QUALITY**

**651-F**
**FLEX-LOC Lamp Holder**

Automatically self-adjusting. Engineered to fit ALL STANDARD spacings. POSITIVE AUTOMATIC LOCK. PERFECT ELECTRICAL CONTACT. Brass contacts grip BOTH sides of lamp pins securely.

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E.T.L. Test Report 314454 Available
Patented—Other patents pending

**FS-40**
**AUTOMATIC Starter**

CUTS OUT deactivated or flickering lamps. CUTS OUT current to lamp and ballast. Increases life of lamp and ballast.

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**LLOYD PRODUCTS CO.**

**PROVIDENCE 5 RHODE ISLAND**

*Branch Offices and Warehouse Stocks in 27 Leading Cities*


**TABLE I**

| Lighting Units Lighted | Footcandles | |
|---|---|---|
| | On Desk | On Table |
| A-C-E-G | 19 | 22 |
| B-D-F-H | 19 | 22 |
| E-F-G-H | 7 | 23 |
| K-L-M | 12 | 28 |
| A-B-C-D-E-F-G-H | 38 | 46 |
| All units | 50 | 75 |

the prospect first at the desk, then at the table. He is given a newspaper, blueprint, or similar material, to read. The lighting intensities are then turned on in steps from low to high, and back to low, giving the prospect time to react to each new intensity. Thus, the prospect is convinced that light does help to see, and that he needs the highest levels used in the room. "Seeing is believing", and selling something as intangible as light is made relatively simple through the medium of proper demonstration.

## CLASSROOM VISION AND MORALE BOOSTED

A year's use of the model 5th grade classroom in the Bowditch School, Salem, Mass., has proven the predicted benefits of scientifically combining modern artificial illumination, controlled natural light, thoughtful color treatment and selection of comfortable, utilitarian furniture. All factors relating to improved vision, mental receptiveness and student appreciation of environment were considered before altering the 24- by 30-foot classroom.

The room selected for transition was formerly illuminated by nine open bottom semi-direct translucent bowl fixtures, suspended 3 feet 4 inches below the 12-foot ceiling, collectively containing one 100-watt and eight 50-watt inside-frosted incandescent lamps. Oak desks and chairs, deeply stained wooden floors, slate blackboards along three walls and low-reflection wall and ceiling treatments resulted in light levels between 2 and 10 footcandles at desk level in various parts of the room. Opaque roller shades over the four 5- by 7-foot windows (19 percent of the floor area) excluded glare only by also excluding outside illumination.

In renovating the room it was the purpose of the School Committee and the designers, Sylvania Electric Products Inc., to employ near-standard fixtures and follow practical methods which could be economically duplicated in other schools.

Fixtures, blackboards and desks were removed and the color treatment of the

# BORDERLINE VISION*

## Stealing Production Time?

★Just a shade too dark slows down your workers.

★Just right means faster, better work.

## Save Wasted Minutes With Wheeler Skilled Lighting!

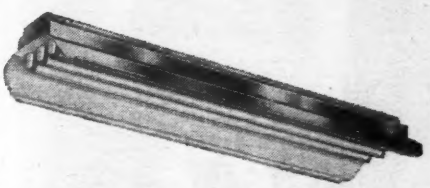
"Borderline Vision" – lighting that's just a shade too dark may be robbing you of precious production time . . .

The time it takes a worker to take a second look. The time – and money – it costs you if work isn't just right. The little slow-downs that add up to an expensive lag in production.

For 65 years Wheeler has specialized in light engineering that eliminates such Borderline Vision. Wheeler Reflectors are designed to *control* light – to put light to work where it belongs – on the job. Their high reflection factor gets top illumination from standard lamps. And their rugged, porcelain-enamel coated construction means longer service – easier maintenance.

Don't be fooled by a lighting system that may look all right at a glance. Better, faster work is almost automatic when you install Wheeler Skilled Lighting. Write for full details on the complete line of Wheeler Fluorescent and Incandescent Reflectors now! **Wheeler Reflector Company, 275 Congress St., Boston 10, Mass.** Representatives in New York and principal cities.

*Distributed Exclusively Through Electrical Wholesalers*



**All-Steel Open-End Fluorescent Unit**

**Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Mounts from chain or conduit, individually or in continuous runs.**

**RLM Solid Neck Incandescent Reflector**

**Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.**

# Wheeler Reflectors

SKILLED LIGHTING

**MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881**

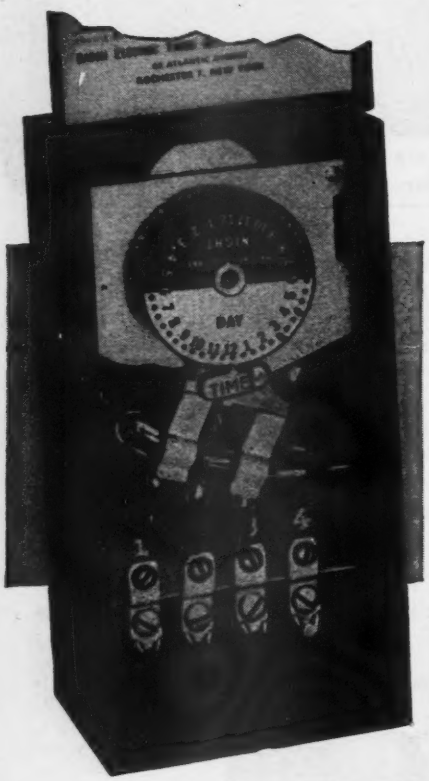
# AUTOMATIC *Time-Control..*

**. . . for poultry lighting and dimming, heating, ventilating, display lighting, signs . . . for practically any time - control operation.**

**Developed in 1936, the Bacon Automatic Switch has these outstanding features:**

- **Performs from 1 to 18 pre-set operation in a 24-hour period.**
- **Will operate as a straight "off-on" switch or in a "dim-bright-dim" cycle.**
- **Only one moving arm is needed to operate the trouble-proof *mercury-to-mercury contacts.* These contacts, enclosed in a shock-proof Pyrex tube are the principal reason for the long-time performance record of the Bacon Switch.**

***Write for Descriptive Literature***



**O.P.A. Retail Ceiling Price $11.00**

**Model 102 illustrated. 1320 watts Others in higher ratings**

**E. D. ROSE**

**SALES AGENT**

**11125 Lake Ave. Cleveland 2, Ohio**


bare room considered. Pale coral was selected as the basic color, achieving cheerfulness and retaining reasonable tonal constancy under both natural and white fluorescent light. Ingredients of burnt umber, burnt sienna, French ochre and dragon red were mixed in varying proportions with a white base to achieve a coral dado, light coral upper walls and off-white ceiling. Window louvres and trim match the wainscoting.

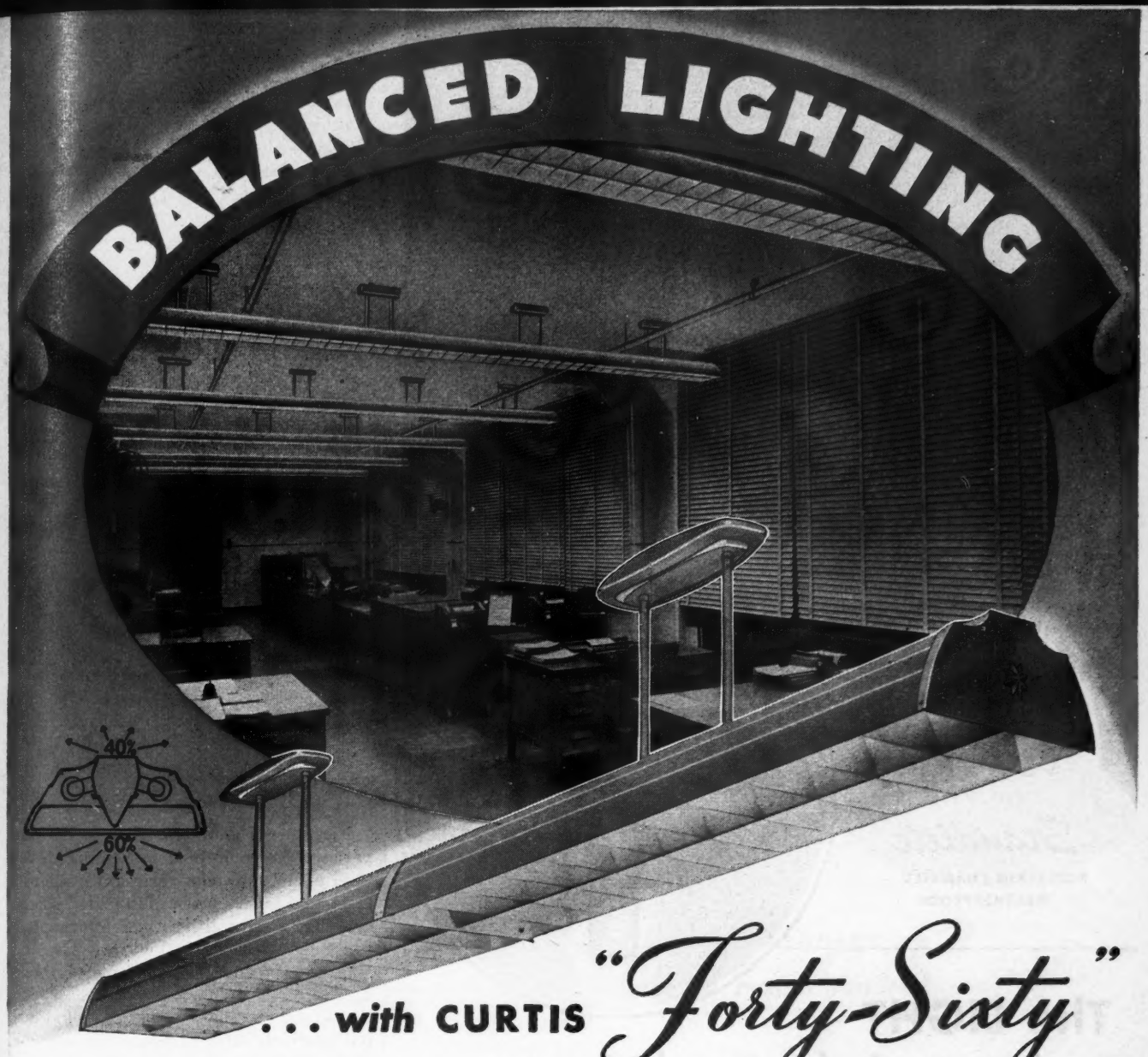
Side and rear blackboards were replaced by Celotex tackboards covered with cotton crash cloth applied in wallpaper fashion and the front blackboard was replaced by a pale-coral-backed glass chalkboard on which blue chalk was used. Teachers were canvassed on their preference between this treatment and the former board and chalk combination and, although the blue chalk was found to smudge fingers, the preference was for the more colorful and cheerful combination.

A marbelized pattern of black and red over a light grey tile floor served to disguise heelmarks and present an acceptable reflection factor. Initial reflection factors in the unoccupied and unfurnished room were .82 ceiling, .68 upper walls, .62 chalkboard, .55 tackboards, .52 lower walls and .34 flooring.

Vertical metal louvres at 90 degrees to the window surfaces eliminate excessive sky brightness at forward angles yet allow unobstructed natural light to reach the far side of the room. By looking directly at the windows, the sky may be seen without irritating glare. On extremely bright days, direct sunlight

***Classroom, prior to renovating, combined insufficient artificial illumination, exterior glare, light-absorbing color treatments and dark, conventional desks.***

***Modern schoolroom incorporates planned, low-brightness, semi-indirect fluorescent lighting, louvred daylight control, scientific color selection and posture-improving furniture.***




## . . . with CURTIS "Forty-Sixty"

### A TWO-LAMP FLUORESCENT UNIT FOR OFFICES, DRAFTING ROOMS AND FOR ANY JOB REQUIRING COMFORTABLE, EFFICIENT SEEING

The "Forty-Sixty" is specifically designed to provide better working conditions for the human eye. 40% of the light is directed to the ceiling and is diffused smoothly throughout the room. 60% is directed down to the working plane to provide ample light for quick and easy seeing. The balanced lighting frees the eye from strain and increases its efficiency. Fixture brightness has been held to rigid limits and scientific louvering shields the lamp at all ordinary angles of view.

The "Forty-Sixty" is an all-metal luminaire requiring a minimum of maintenance because there are no horizontal reflecting or diffusing surfaces to collect dust. Alzak Aluminum reflecting surfaces are easy to clean and reflect the light from the ceiling with a pleasingly luminous effect

These units are ideal for individual mounting or for use in continuous runs. If you do not already have data on Curtis "Forty-Sixty" write for it today

**CURTIS Lighting**
INC.
6135 WEST 65th STREET
CHICAGO 38 • ILLINOIS

GOODRICH
No. 77
*Standlite*
PORCELAIN ENAMELED—
WEATHERPROOF

# The LIGHT
## that stands for Speedy Service

You'll see them from the highways—in service stations from coast to coast. For the Goodrich Standlite is a "standout" in the service station field. It is popular because it provides the modern high intensity illumination that indicates click-of-the-heels service—attracts patronage—builds business.

There's more to their popularity than neat appearance. By bringing the light source close to the ground, they provide high efficiency lighting for the entire servicing area around pump islands. And they're easy to install, easy to service.

The Standlite is only one of the many distinctive Goodrich lighting fixtures designed for specific purposes. Whatever your lighting requirements may be, indoor or outdoor, there is a Goodrich fixture to exactly suit your needs. And Goodrich engineers are ready to help you.

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is diffused through light translucent roller shades. The metal louvres are slightly S-shaped, spaced at 3-½-inch intervals, 4 inches in width.

Furniture (reflective factor of .30) was designed to promote proper posture, comfort and mental alertness. Adjustable chair backs are at right angles to the 18½ degree incline of the light tan birch desk tops with a rubbed oil finish.

Present lighting consists of nine standard commercial shallow V-shaped semi-indirect fixtures, suspended 2 feet overall from the ceiling, each unit containing four 40-watt-white fluorescent lamps. The light-diffusing glass side panels are of different densities, the panels facing the students having a lamp-side ceramic coating. Low brightness on the side facing the students eliminates glare while strong illumination is directed towards the front of the classroom. This arrangement is beneficial for both students and teachers alike since the teacher's desk is located at the rear of the classroom in accordance with modern educational trends. The fixtures are mounted in three rows, each row having three units. Spacing is symmetrical with respect to the center of the ceiling with 10-foot distances between fixtures at the front, center and rear of the room and 8-foot center-to-center spans between units located in the left, center and right longitudinal rows.

Light meter readings, taken in various parts of the room on a horizontal desk-level plane, showed a variation from 183 to 15 footcandles when illuminated solely by exterior natural light nor interrupted by window shades or louvres. The installation of the louvres reduced these figures to 107 and 11, a material reduction in the readings nearest the windows but relatively little change at the interior wall. With fluorescent lighting as the only source of illumination, these readings ranged from 38 to 46 footcandles. With pupils at their desks, approximately 5 percent of the light is absorbed and the 18½ degree incline of the desk-tops further reduces these figures so that the resultant desk angle readings in the occupied room are between 29 and 39 footcandles. During daylight sessions, with a combination of natural and artificial illumination, the readings are kept constantly above 40 footcandles through switches. Three switches control the fixtures; the first operating the three units furthest from the windows and two lamps in each of the three centrally located luminaires, the second controlling two lamps in the six units nearest the windows, the third controlling the remaining two lamps in the fixtures closest to the source of exterior light. The lights on the darker side of the room are kept burning constantly and the remainder turned on or off depending on the brightness of the day.

**Bunting Bronze Bars and Standard Bearings are procurable from distributors' stocks in many hundred cities.**

**The name Bunting long has been synonymous with finest quality. The availability is immediate—from your nearest Bunting Authorized Distributor. Write for Catalog. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Branches in principal cities.**

# Bunting

43

BRONZE BEARINGS ☆ BUSHINGS ☆ PRECISION BRONZE BARS

# Type HL-50 Weatherproof Socket

MOLDED BAKELITE

WITH PATENTED THREADED SHANK

*HL-5 with plain shank*

*HL-50 with threaded shank*

**HL-50 molded weatherproof socket is unusually useful in many types of permanent or temporary installations. Standard guards and reflectors with 1½ inch fitter can be attached. Leads are permanently molded in the Bakelite body. The ½ inch pipe threaded shank molded integral with the body is a patented feature that permits mounting in Pylet conduit hubs, steel knockout boxes, rigid conduit couplings, or in ¾ inch garden hose. The threaded shank seals the installation. Use Type HL-50 indoors or out, for portable hand lamps, cluster lights, lamp or attachment plug outlets, and any similar work needing a rugged, heavy duty outlet.**

**Also made as Type HL-5 weatherproof socket without pipe threaded shank.**

**Consult your Pylet Catalog 1100 for complete listings.**

THE PYLE-NATIONAL COMPANY

1346 N. Kostner Avenue, Chicago 51, Illinois


# MODERN LIGHTING IN AUTO DISPLAY ROOM

Automobiles are *bought* today—not *sold*. With a pent-up demand which will take several months to meet, motor car dealers worry about allotments, not how to display new cars to best advantage.

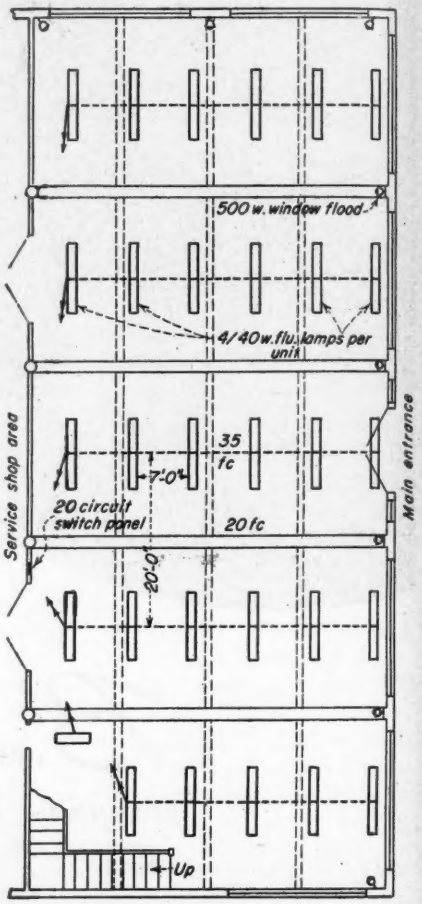
Far sighted dealers, however, know that once the manufacturers get under way with production, the unprecedented demand for new cars will gradually be satisfied. Once again, it will be necessary to use salesmanship to sell an automobile. Display techniques will have to be employed, to show up the automobile to best advantage, and to point up its best features.

The Chesapeake Cadillac Company, Baltimore, dealers for the General Motors Cadillac, have already modernized their showroom. Modernization included installation of a suspended acoustic ceiling to conceal part of the beam construction, and of a modern fluorescent lighting system.

The lighting layout was planned by H. M. White, illuminating engineer with the Consolidated Gas Electric Light and Power Company of Baltimore, in cooperation with Roland Electrical Company, electrical contractors, who sold and installed the lighting system.

The new lighting consists of 29 eight-foot lengths of Pittsburgh No. PF-248 fluorescent units installed flush in the ceiling, and equipped with Holophane intensive type lenses. Each unit contains four 40 watt 3500° white fluorescent lamps. These units are installed seven feet apart in each of the five bays, which are 20 feet wide. The ceiling height is 13 ft. 4 inches, and beams dividing the bays are 19 inches deep. The ceiling is white, and side walls a light tan. Light intensities range from a low of 20 footcandles under beams, midway between lighting units, to 35 footcandles under the units in the center of a bay.

Rewiring included installation of duplex convenience outlets on pilasters above windows, for 500 watt show window floodlights. These floodlights, which had not been installed when the accompanying photograph was taken, will be used to accent the automobiles displayed next to the windows.



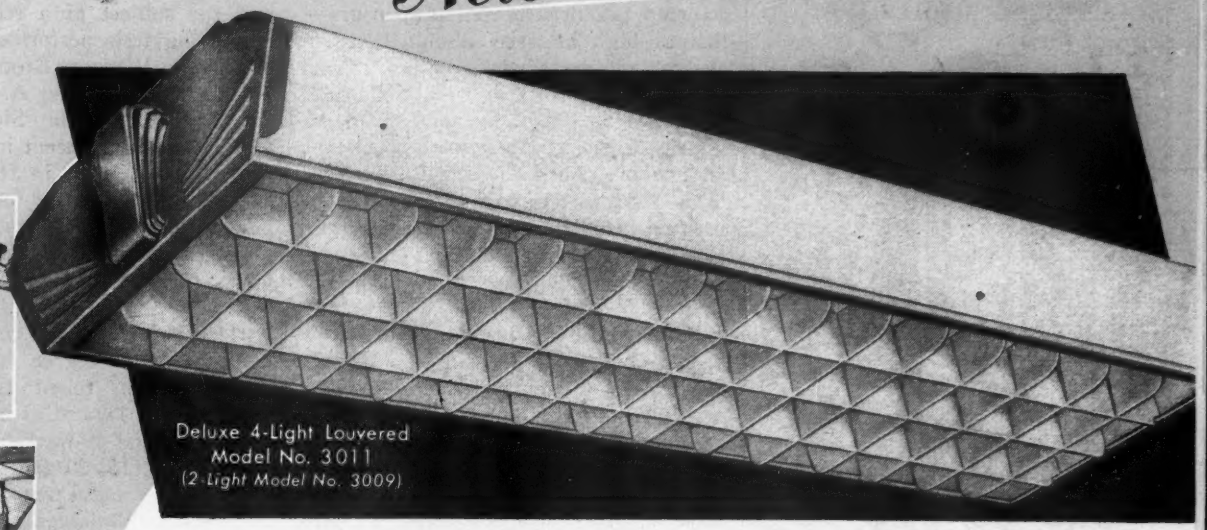

***Plan shows lighting layout in the Chesapeake Cadillac Company's automobile salesroom, Baltimore, Md.***

***Large display room is ready for new automobiles. Cadillacs will be featured, and new fluorescent lighting will accent their lustre and many outstanding features.***

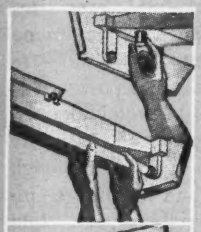
*New* DESIGNS!

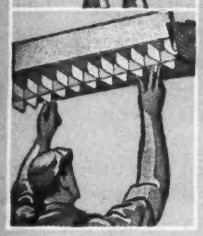
*New* FEATURES!

*New* LIGHTING EFFICIENCY



Deluxe 4-Light Louvered
Model No. 3011
(2-Light Model No. 3009)

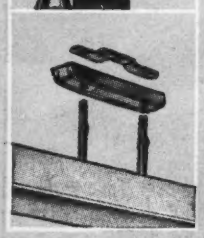


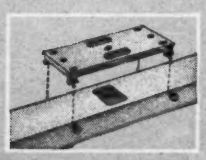


IN THE *New* COMPLETE LINE OF

# MITCHELL

## Commercial Luminaires





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- Higher Light Output—Less Glare
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- Proper Lamp Spacing
- True, Full-Depth Louvers
- Luminous End Plates
- Instant Start
- Surface or Suspension Mounting
- Quick, Easy Installation and Servicing
- One-Man Quick-Mount
- Fleur-o-Lier, U.L. and E.T.L. Approved
- Single Carton Packing
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You readily solve every commercial lighting proble for stores, offices, schools, and public buildings . with the complete new MITCHELL fluorescent line! Y provide new lighting comfort and efficiency . . . a new style and beauty, offer more value per dollar. F MITCHELL ingenuity brings you new modern desig in 2-light and 4-light units . . . glass-shielded, louver and open types . . . Instant-Start . . . new patented "Or Man Quick-Mount" . . . and other features! Installati is simpler than ever. Maintenance is made easier f servicing economy. With the complete and power selling set-up MITCHELL provides, you have an unlimit opportunity for volume sales and profits.

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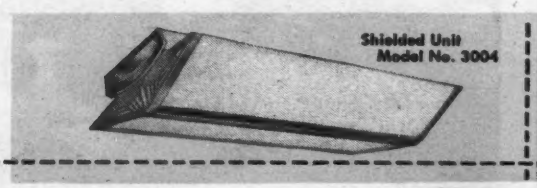


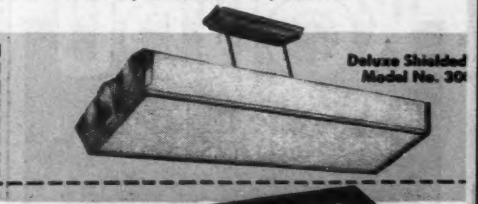


**Get New Catalog No. 285**

Illustrates and describes the complete line of Commercial Luminaires. Includes helpful lighting data and servicing information. Write for it now.

**See Our Catalog in Sweet's**

For convenient reference, Mitchell Commercial and Industrial units are cataloged in Sweet's 1946 Architectural and Mechanical Industries Files.

MITCHELL
FOR TOP LIGHTING VALUE

Makers of Commercial and Industrial Fluorescent Lighting Equip
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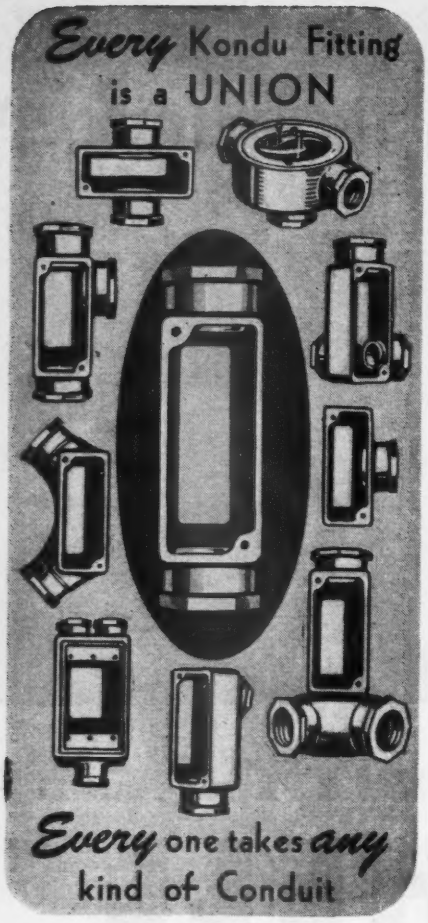



**Only with Kondu** can you take one fitting out of the line and put in another, without disturbing conduit . . . **only with Kondu** can you put up a conduit line before the fittings are delivered . . . because *every Kondu Fitting is a union.*

**Only with Kondu** can you use either standard conduit or thin-wall tubing, at any outlet of any fitting. Just slip out one bushing and slip in another . . . no extra pieces are needed.

Kondu fittings hold permanently tight . . . are vibration-proof. Practically unbreakable . . . 100% re-usable. Self-aligning. Roomy enough for all splices.

*Write for the Kondu Catalog.*

**KONDU CORPORATION**

**Erie, Pa.**

KONDU MFG. CO. LTD., Preston, Ontario

## 100 FOOTCANDLES PROMOTE ALERTNESS

The office-salesroom of the North Coast Electric Company, Portland, Oregon, exemplifies a trend which that company practices as well as sponsors—that of high intensity illumination for clerical and secretarial workers. Over 100 footcandles on the horizontal working plane and 50 footcandles on desk-high vertical surfaces were measured and double checked with Weston and G. E. light meters 11 months after the lighting installation had been completed. Readings of 135 footcandles were recorded immediately after mounting the fixtures.

Mounted directly to the 12-foot 6-inch ceiling with row spacings of 6-feet 10-inches are continuous runs of Guth semi direct Aristolite fixtures, each unit containing four 40-watt 3500 degree white fluorescent lamps. The consumption due to lighting is 5.7 watts per square foot. Glass diffusers with mitred corners, etched borders and reinforcing steel edges are set in shallow Vs that reflect sufficient light upwards to illuminate the off-white natural acoustical ceiling. Walls are harmoniously painted a light pastel green.

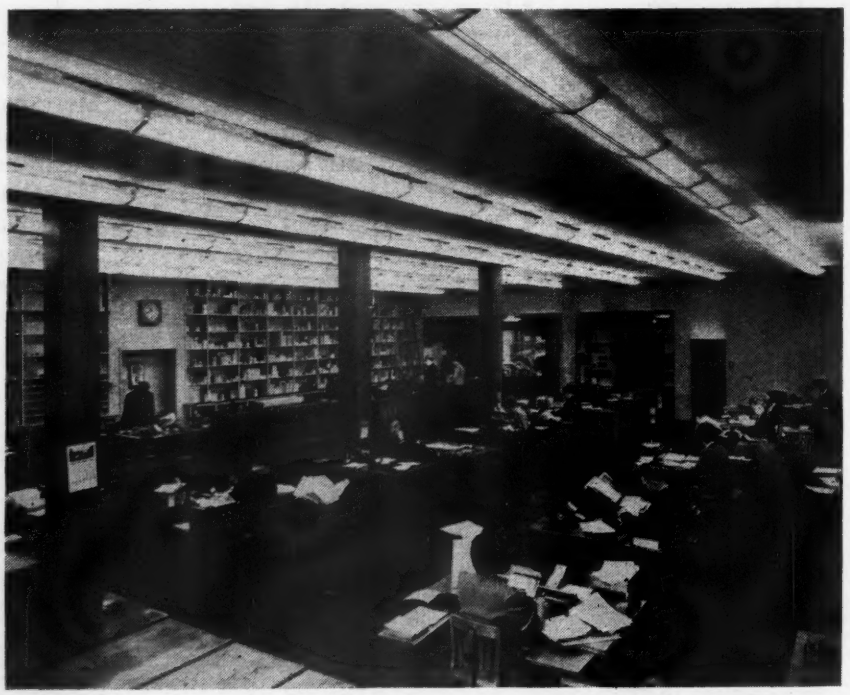
Employees working under these conditions of high intensities have experienced no eye fatigue while mental alertness, accuracy and efficiency have noticeably improved.

The installation was engineered by L. M. Baxter for the Guth Co. and installed by the Gross Electric Company. electrical contractors of Portland.

## COLD CATHODE TESTED WITH INCANDESCENTS

The relative merits of cold cathode tubing and incandescent lamps for backlighting theatre marquee sign lettering was the subject of a recent series of interesting tests performed by Herman Meyer of Warner Brothers Pictures' New York office and A. P. Trucksess of the Philadelphia Sign Company. Opaque and translucent interchangeable letters were placed in front of $\frac{1}{8}$-inch sheets of both pot opal and flashed opal glass mounted in standard Wagner frames on specially constructed sign boxes. Mounting plates behind the frames held incandescent bulbs on 8-inch horizontal and vertical centers and cold cathode 3500 degree white vertical U-tubes with tube-to-tube distances of 4 inches. Two sizes of incandescent lamps (25 and 40-watt) and three sizes of U-tubes (15, 20 and 25 mm. tubing under $7\frac{1}{2}$, 6 and 4 mm. pressure) were employed for illumination purposes. Surrounding temperatures between 60 and 5 degrees F. were created. Tests were carried out in a room which, although not in total darkness, had insufficient infiltrating light to register on a light meter. The recorded comparative light outputs, computed economic factors and estimated aesthetic values contribute factual data to a subject of considerable debate.

Since it was observed that tube image was apparent when the glass-to-lamp distance was less than $2\frac{1}{4}$ inches, this measurement was maintained at $3\frac{1}{2}$ inches during the experiments.



***Semi direct, surface mounted fixtures, placed end to end against a natural acoustical ceiling, supply high levels of illumination at desk height. Each unit houses four 40-watt while fluorescent lamps.***

# BEFORE and AFTER

## PICTURE SEQUENCE REVEALS LIGHTING STRIDES TO EFFECT BETTER SEEING

Illuminating technique marches on! These three photographs of stages in lighting progress as applied in a division of the Acme Steel Company's general offices at 2840 Archer avenue, Chicago, virtually speak for themselves. They present the "before and after" theme in double sequence. While emphasis is on increased light for improved visual aid, also evidenced is the reciprocal control of brightness contrasts.

In the second stage, improved ceiling reflectivity has alleviated overhead structural shadows, reducing uneven brightness patterns as well as adding to illuminating efficiency.

With the recent installation of continuous-row fluorescent lighting, recessed in a false ceiling, structural shadows in this area have been entirely eliminated. Also effected is a more even distribution by the use of linear source lighting. Although fluorescent tubes have a relatively low surface brightness, diffusing glass at the bottom of the two-lamp reflectors provides added brightness control. Significant, too, is the treatment of the walls and pillars with respect to light reflectance. In this manner, focal adjustments during the normal pattern of eye movement are moderated and eye comfort aided.

In pace with the achievements effecting improved seeability have been parallel strides in the efficiency of the lighting sources themselves. Wattages and resultant intensities of the installations pictured above presents this interesting comparison: 600 watts per bay, 10 footcandles; 1,000 watts per bay, 25 footcandles; and 800 watts per bay, 50 footcandles, respectively. More and better light—with more light per watt!

Reprinted from Edison Industrial News, April-May 1946

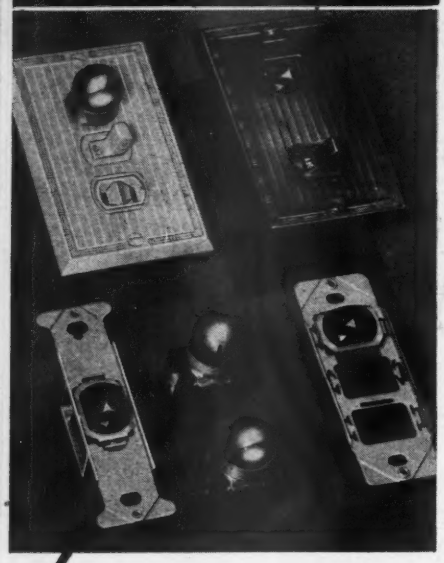
***LIGHT RIGHT WITH ALL-BRIGHT***

***ALL-BRIGHT ELECTRIC PRODUCTS COMPANY***

*Manufacturers of Fluorescent Lighting Fixtures*

**3917 N. Kedzie Ave.** **Chicago 18, Illinois**

P&S
PILOTS



THE WAY TO
SAFETY
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Versatile — compact — suitable for a variety of installations — P&S Pilot Lights illustrated may be combined with P&S-Despard switches or outlets under a single gang plate.

Flush type available with red, green, blue, amber or opal jewels — Hooded type with red or clear lamps.

Also note Night Light unit which permits installation of switch-controlled night light in single gang with switch or outlet.

Consult your P&S Catalog if you have a pilot light problem.

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PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK

With the temperature at 60 degrees and with glass fronts removed, meter readings taken 3½ inches from the bare 40-watt, 25 mm., 20 mm., 15 mm. and 25-watt lamps were, respectively, 500, 500, 460, 350 and 310 footcandles. At a distance of 5 feet from the frame line, these readings were reduced roughly 91 percent. Alternately inserting the glass panels into the frames evenly diffused the light over the entire frame area. Readings, taken at the surface of the glass, showed that pot opal transmitted 50 percent of the light while flashed opal transmitted 65 percent. At a distance of one foot these readings became, respectively, 60 and 58 percent. At greater distances the meter readings of the diffused light were found to remain at approximately 60 percent of the bare lamp intensities. An analysis of these tests indicated that the use of cold cathode tubes as a light source for theatre marquee lighting is reasonably satisfactory when using 25 mm. tubing in conjunction with a 12,000-volt 120 ma. power factor type transformer and flashed opal glass. At 60 degrees F., light readings taken one foot in front of the flashed opal panel showed an intensity of 350 footcandles from the 40-watt lamps and 320 footcandles from the 25 mm. U-tubes.

To determine the effect of temperature on output, the 25 mm. cold cathode sign box with flashed opal glass was placed in the cold box of the University of Pennsylvania's Thermo-dynamics Research Laboratory. Down to 35 degrees the measured light intensity was over 300 footcandle and, at 35 degrees, the temperature inside the sign box was recorded at 58 degrees. Below 35 degrees the meter readings fell approximately three footcandles per degree of temperature so that, at 21 degrees (inside box temperature 39 degrees) the reading was 250 footcandles and at 13 degrees (inside box temperature 25 degrees) the reading became 200 footcandles. At five degrees (inside box 20 F.) the reading became 170 footcandles. At plus seven degrees F. the box was left unlighted for some time, after which period low temperature starting was attempted and instantly achieved. The results of this test indicated that temperatures below the freezing point definitely affect cold cathode lighting. Normal winter temperatures between 28 and 43 degrees result in only slight decreases but below 25 degrees the decrease becomes rapid so that only two-thirds of the original light output is registered at 13 degrees and this reduces still further to 50 percent output at zero degrees. Although no tests were made with incandescent lamps, it is accepted that they are not seriously affected by low temperatures.

From an economic study it becomes apparent that the initial cost of cold cathode lighting is much in excess and annual lamp replacement charges are greater than an incandescent installation. The consumption and utility charges, however, are less. The 25 mm. tubes, arranged on 4-inch centers, vertically, develop approximately 32 watts per square foot of glass area. An average marquee will carry three lines of lettering and 60 lineal feet of glass surface, totaling 6.7 kw. consumption. Using 40-watt incandescent lamps on 8-inch centers gives 82 watts per square foot or a total of 17.2 kw. for an average marquee. The indicated saving by using cold cathode tubing is 10.5 kw. and, assuming an average current charge of one cent per kwh., lighting the marquee from dusk to midnight, the yearly current saving becomes approximately $190. Higher current rates and longer burning times would naturally increase this amount.

Basing incandescent lamp life at 1000 hours and using 2000 burning hours a year as a basis of comparison, incandescent replacement would approximate $92 annually. Although cold cathode tubes have lives of from 8000 to 10,000 hours, the tubes will darken towards the end of this span and a life of only three years is estimated (6000 hours of use). On this assumption, a comparable installation of cold cathode would involve an annual lamp replacement charge of $190.

Cold cathode lighting, because of the necessity of series operation, results in a considerable portion of the sign being dark when a single tube becomes inoperative whereas, if an incandescent lamp burns out, it darkens only a small portion of the glass surface.

From the tests it was intimated that cold cathode does not have the tremendous potential savings that were at first contemplated. The original cost is considerably greater and the saving in current would be wiped out by the greater replacement charge. The aesthetic value was considered a definite improvement over incandescent lamps, inasmuch as the almost pure white effect of the illuminated glass surface was much more striking and vivid than the ivory or cream effect with incandescent lamps.

Similar tests performed four years ago by the same parties showed far wider differences between the two light sources and the present tests showed that cold cathode lighting is advancing rapidly into an ever changing lighting field. The debatable question still remains of whether the additional cost of a cold cathode installation is warranted by the differential current savings and the aesthetic improvements obtained. The factors will undoubtedly change in the near future but present adoption largely depends on weighted intangibles.

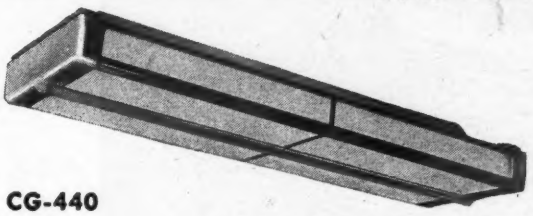
ADVERTISEMENT

SYLVANIA NEWS
CONTRACTOR EDITION

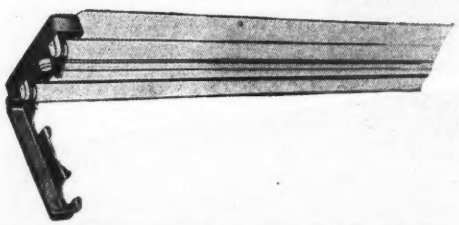
JULY *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass. 1946

# NEW "BASIC-CHASSIS" FIXTURES EASY TO INSTALL; MAINTENANCE NO PROBLEM

Equipped with glass diffusing panels, this four-40-watt fluorescent fixture is styled to fit the most exclusive shops and offices.

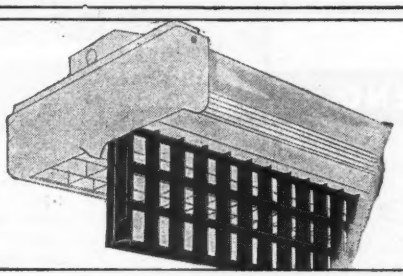


CG-440



The end caps of the basic C-440 and C-240 (2 lamps) snap open and swing down for starter or lamp replacement.

The shield assembly of the CL-440 (and CL-240) lifts and hinges downward to expose lamps. The complete shielding may be removed for cleaning.



## *Versatile New Units Combine Fluorescent With Incandescent Lighting*

Sylvania's new "440" and "240" lines of commercial fluorescent fixtures, built around one basic chassis, greatly simplify installation and servicing.

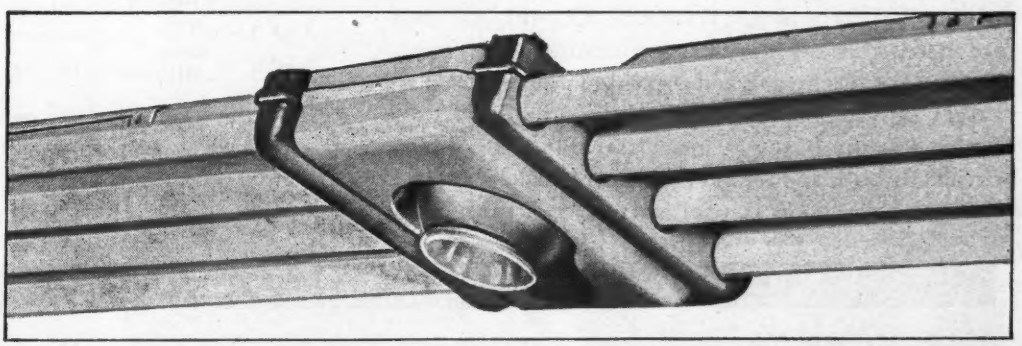
Because these new fixtures are all in the same "design family," glass-shielded, louver and exposed-lamp models will blend tastefully in one large installation. They can be surface- or pendant-mounted, individually or in continuous rows — assuring a wide range of uses for these versatile new fixtures.

For quick, easy maintenance, both the shield assemblies and end caps of these new lines hinge downward for relamping and changing starters. As in all Sylvania commercial fixtures, this servicing can be done quickly without using a single tool.

Also in this "design family," Sylvania's new CP-150 spotlight is readily incorporated with the "440" and "240" lines, to form a combination fluorescent and incandescent lighting unit.

## VERSATILE FIXTURES COMBINED WITH NEW SPOTLIGHT

Here is the new Sylvania CP-150 spotlight centered between two C-440 fluorescent fixtures for combined general and accent lighting. The CP-150 "ball-and-socket" spot is specially constructed so that light may be directed to desired positions.



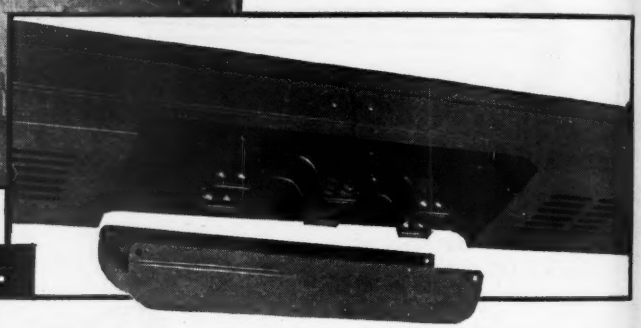
SYLVANIA ELECTRIC

MAKERS OF FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

# TRUMBULL

## FEEDER DISTRIBUTION SYSTEMS

*"Like a broad and safe Electrical Highway through the plant"*



**The new improved type connection and cover simplify installation . . . no special tools required. Cover quickly removed for inspection . . . lots of room to work. Now easier than ever to take off taps from L.V.D. Systems.**

## . . . and easy to get . . . NOW!

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**PRACTICAL ARTICLES** on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

# Electronics

## Electronic Adjustable Speed Drive at Work

By Harold J. Hague,
*Electronic Application Engineer*
*Westinghouse Electric Corporation*
*East Pittsburgh, Pa.*

WHILE it is true that the electronic adjustable speed drive has not been available for general use until the past few years, the drive has been in use for a number of years. One of the first installations was made approximately ten years ago on a capacitor winding machine. Capacitors, both the small ones used in the radio or the large industrial ones used for power factor correction, are usually composed of two sheets of thin metallic foil separated by some insulating (dielectric) medium such as a sheet of impregnated paper. In the manufacture of these capacitors it has always been a problem to wind them with uniform tension to insure good insulation. Today the electronic adjustable speed drive is used for this purpose as shown in Figure 1. The operator of the winding machine controls the speed of the capacitor winder by moving a foot-operated speed adjuster consisting of a variable reactor with a foot treadle. In addition to providing continuous speed adjustment from zero to maximum winding speed, greatly increased production resulted because of the smoother speed control available to the operator.

One of the outstanding features of the adjustable electronic speed drives is the fact that the drive saves floor space. Figure 2 is a plant view of a West Coast manufacturing company and illustrates the amount of equipment formerly required on a 30 year old grinder used for machining hardened pump liners with a finished tolerance of .001 of an inch. The variations in liner sizes required grinding speeds over a much wider range than was available with the overhead pulley arrangement, and in addition the various liners required a closely regulated stepless range of speed in order to secure the desired tolerance and finish. Figure 3 shows the modernized grinder. The overhead equipment has been replaced with the electronic adjustable speed drive with a saving in floor space, increased safety, improved illumination, and the elimination of vibration. The stepless quality in speed regulation available with the electronic adjustable speed drive permits the operator to choose the right speed for the hole in the liner, the material to be finished, the grit and the grade of the wheel to be used. The right speed for the grinding operation helps eliminate vibration and chatter marks in the work and thereby results in a straight true round hole. The latter condition represents an ideal condition for the honing operation. If the hole is not straight and true, then the hone is apt to follow any irregular condition of the ground hole.

The time study department of the manufacturing company reports that an appreciable saving has been effected in the setup time as a result of the better

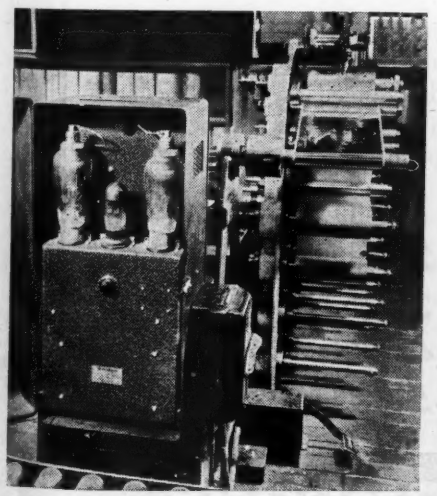

***Fig. 1—Electronic adjustable speed drives applied to a capacitor winding machine. The speed of the motor is controlled by the foot pedal.***

***Fig. 2—Before installation of the electronic adjustable speed drive speed changes were made by lever.***

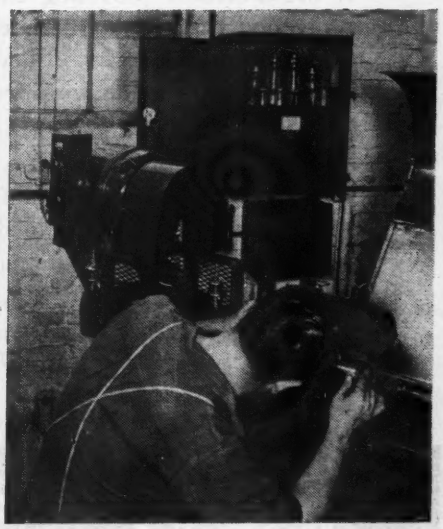

***Fig. 3—Electronic adjustable speed drive is compact, space saving and convenient.***

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The Square D Multi-breaker provides the necessary disconnecting means required by the National Electrical Code, in addition to furnishing separate automatic overload protection for the wiring serving each major appliance. A Multi-breaker providing this added convenience and protection, installed in the kitchen, costs your customers no more (sometimes less) than the old-fashioned method of running long circuit wires from a remote point.

Multi-breakers eliminate fuses completely. Current is cut off automatically when a short circuit or overload occurs. A simple movement of the lever restores current after the cause of the overload has been removed. There are no delays, nothing to replace.

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**Permanently built-in electrical appliances now may be included in house-financing plans in many states.*

### Protect major appliance circuits with a MULTI-BREAKER

Top illustration shows Square D Multi-breaker located in kitchen and arranged to control general lighting and these major kitchen appliance circuits:

1 · Range
2 · Garbage Disposal Unit
3 · Dishwasher
4 · Refrigerator
5 · Food Freezer Unit

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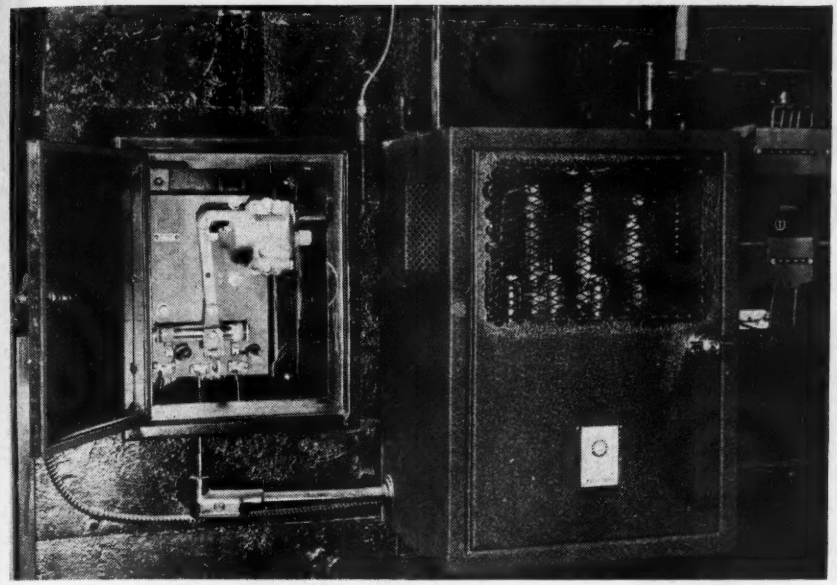


***Fig. 4—Electronic adjustable speed drive applied to a stoker. The pressure regulator is connected to the steam line. Variation in the steam pressure causes the pressure arm to move and this in turn varies the setting of the slide wire potentiometer. The slide wire potentiometer takes the place of the speed control dial on the standard control station.***

illuminated working area and less complicated controls and speed changing apparatus of the grinders.

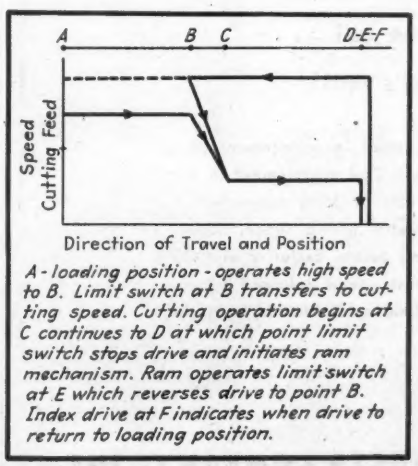
For a number of years many mechanical arrangements have been used for automatically controlling a stoker such as used in central power plants or in electric power generating stations. The majority of the mechanically controlled stoker drives regulated the flow of coal to the firebox by noting a change in the boiler pressure somewhere along the steam pipe line.

The electronic adjustable speed drive can also be adapted for controlling a stoker such as used in central power plants or electric power generating stations. Advantages of this type of drive for stokers are; automatic close control of boiler pressure, low initial installation costs, low maintenance cost, and saving in floor space.

The equipment that is used for automatically controlling the stoker consists of the standard electronic adjustable speed drive (Figure 4) and a separately mounted actuator, the latter being used to control the speed of the drive. The small control dial (or potentiometer) is divorced from the standard control station and is replaced by a slide wire type of potentiometer in the separately mounted actuator cabinet. The actuator in this case is a standard pressure indicating device that is connected in the steam line position. The displacement of the arm of the actuator bears a linear relationship to the pressure that exists in the steam system, and therefore the arm can be directly connected to the speed control potentiometer. A change in the setting of the actuator arm results in a change in the speed control potentiometer setting, and hence automatically changes the speed of the stoker motor in accordance with the change in the load conditions of the boilers.

Excluding the advantages as discussed previously, perhaps the most outstanding feature of the electronic adjustable speed drive is the fact that it can be adapted for operation in accordance with a predetermined cycle.

For example, Figure 5 graphically illustrates the operation of a gear grinder by showing the relative positions of the sequence of operations of the feed table. The gear blank is loaded on the feed table at position A and the operator starts the sequence of operation by depressing the "start" pushbutton on the master control panel and the feed table moves in towards the grinder at a rate that is determined by the setting of the speed control potentiometer. At point B a limit switch is tripped by the motion of the feed table and the limit switch transfers the speed from speed control dial No. 1 to speed control dial No. 2. Speed setting No. 2 is the cutting speed. The feed table then moves through the cutting operation to point D at which point a limit switch is initiated and stops the feed table. In order to move the grinding ram out of the path of the feed table the limit switch initiates a second drive that moves the ram out of the path of the feed table. A limit switch on the ram acts as a reversing pushbutton and causes the drive to reverse at a high speed. At B a limit switch is initiated which returns the drive to its former direction of rotation and transfers the speed to the cutting speed range.




*A - loading position - operates high speed to B. Limit switch at B transfers to cutting speed. Cutting operation begins at C continues to D at which point limit switch stops drive and initiates ram mechanism. Ram operates limit switch at E which reverses drive to point B. Index drive at F indicates when drive to return to loading position.*

***Fig. 5—Operating cycle of a gear grinder.***

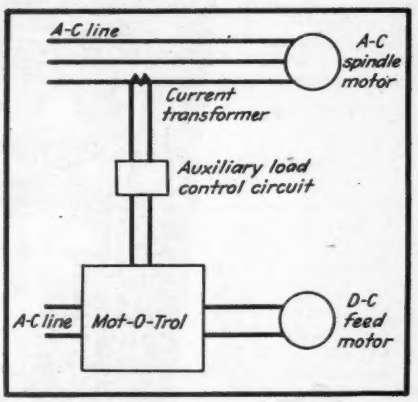



***Fig. 6—Schematic circuit diagram for single motor load control.***

Obviously the above arrangement is very satisfactory, however, it is recognized that some means must be provided to return the feed table to the loading position after a given number of teeth have been cut. To determine the total length of the above cycle, an indicating device is added to the feed table. Actually the indicating device can be a small counter that will count the number of reciprocating motions of the table and, at the end of a given number of returns, will operate a contact in such a manner that it bypasses the limit switch at point B. As soon as the feed table is returned to point A it is stopped by dynamic braking, which is also used to stop the drive at point D.

Frequently it is found that the operator of the machine would prefer to grind a few samples without going through the complete cycle of operation. Therefore, a jogging or inching arrangement has been included in the drive. The jogging arrangement is such that it can be operated in either the forward or reverse direction, and the limit switches with the exception of those located at points A and D have no control on the speed.

As has already been discussed the elec-

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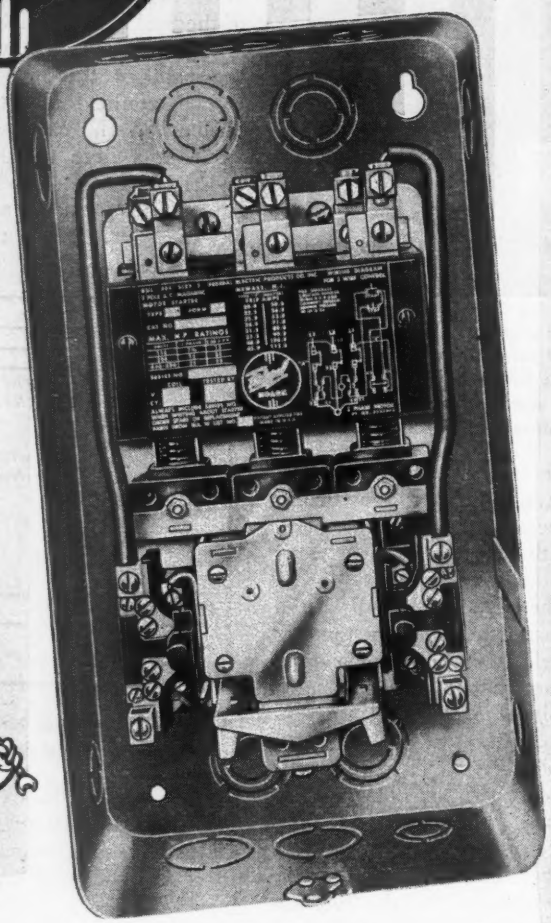
## MOTOR STARTER



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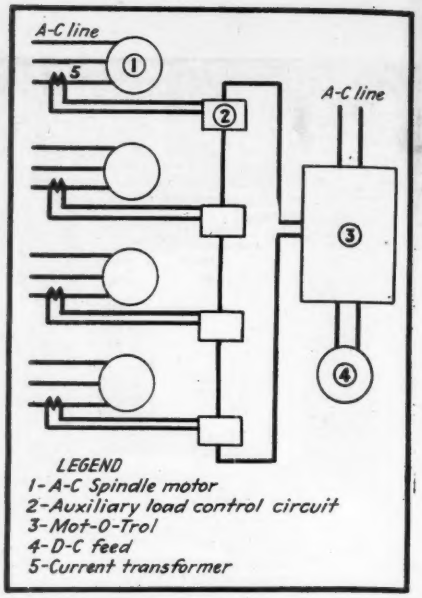


***Fig. 7—Schematic circuit diagram for multi motor load control.***

tronic adjustable speed drive is quite versatile. It can be designed for automatic sequencing, operated on any commercial alternating current power supply, built in the machine, and used for many other special requirements. One of the most interesting applications is the use of the drive for controlling the load on the spindle motor of a milling machine used to rough cut a casting where the load often varies. For example, if the machine is milling a slot in an irregular shaped casting, the rate at which the metal is being removed varies. Variation in the rate of removing the metal means that the load on the cutter (a cutter motor) will vary almost in proportion to the variation in the metal being removed. Hard spots and variations in the composition of the metal will also result in variations in loads.

If the metal is removed at too great a rate, the cutter will break or else the motor will overload depending on which is the weaker component. Thus, the rate at which the cut is made and the rate of feed depends largely upon the worst condition that will be met for the work being machined.

Very often the object being machined is irregular in shape so that the maximum load conditions last for only a relatively short time with reference to the time required for the entire machining operation. Thus, the cutter is actually removing the metal at a much lower rate than normally would be expected.

Fundamentally the electronic adjustable speed drive is used to maintain a motor at a given speed. However, it is relatively easy to add an additional circuit that can change the speed of the feed motor automatically and control the load on the cutter so that the load is maintained nearly constant. Thus, the load on the cutter or motor never exceeds a safe value regardless of the variations

in the depth of cut or hardness of material. The added circuit measures the load on the spindle motor by means of the current transformer (to reduce the current to a value that can be handled by the circuit components), and feeds the current into a rectifier which changes the current into a direct current reference current that is proportional to the cutter motor load. The reference current is then balanced against a standard reference in the main control circuit in such a manner it effectively controls the speed of the feed motor.

Figure 6 shows the arrangement of the electronic adjustable load control drive when one spindle is employed. Figure 7 shows the arrangement of the drive when four milling cutters are used. Actually any number of cutters can be used. When more than one cutter is used, the outputs of the rectifiers are connected in series. On most circuits the arrangement would result in the final output being either the sum or difference of the currents. However, with the arrangement as used in the electronic drive, the current flowing in the output circuit is proportional to the maximum current on any one of the motors. With the above arrangement, the feed motor maintains the desired load automatically on at least one of the spindle motors at all times. The load on the remaining cutter motors will then vary from no load to full load depending upon the depth of cut.

In some instances the spindle motor is special and the current is not proportional to the load. In such cases, the circuit can be modified to operate on kw. input to the motors rather than the current input.

The operator can adjust the load on each spindle independently and can limit the maximum feed speed. Different size spindle motors can be used; the variations in current being compensated for by changing the current ratio of the transformers. Different size cutters can be used. The system can operate automatically as described or by throwing a small switch the drive will operate as a conventional drive.

The drive effectively increases production and reduces production cost by eliminating the breaking of the cutters.

In addition to the applications discussed, the electronic adjustable speed drive finds many other applications, a few of these are; lathes, feed pumps, fans, saws, drill presses, other machine tools, winder drives, printing presses, sound recording, conveyors, wire drawing machines, glass making machines, magneto testing and governor testing. In general the drive can be used to advantage where a wide speed range and good speed regulation is required, smooth automatic acceleration is needed, and where a-c power is available.


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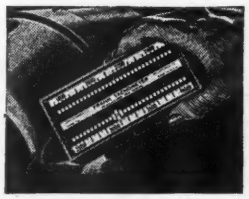

**The FRAHM VIBRATING REED TACHOMETER** *requires no contact with the rotating element and is unique for measuring speed of totally enclosed machines and other equipment where the end of the shaft is not accessible. The only mechanism is a set of accurately tuned steel reeds which vibrate by resonance according to the speed of the machine on which the instrument is held. For hand use in servicing, installation and maintenance work; also built in types for permanent mounting. Various ranges available from 900 up to 100,000 rpm. Used also and in the same way for measuring rates of vibration.*

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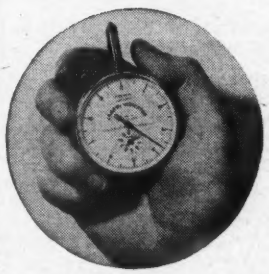
**JAGABI PRECISION HAND TACHOMETER.** *Five ranges in one instrument. Simply rotate the barrel head to change to any one of the five ranges—60-240, 200-800, 600-2400, 2000-8000, 6000-24000 rpm. Measures rpm and fpm by direct pointer deflection . . . fly-ball governor principle . . . large, easy-reading dial with two scales nearly 6½" long. . . . Accurate to within one scale division. . . . Independent of direction of rotation. . . . Supplied complete with case and accessories.*

*Write for descriptive Bulletin 1800-EC.*

**JAGABI HAND TACHOSCOPE.** *A combined speed counter and stop watch with synchronized start and stop mechanism for measuring average speeds and constant rates of speed to a high degree of accuracy. Used for routine tests as well as for checking other speed-measuring instruments up to 20,000 rpm. Can be used also for measuring linear or peripheral speeds. Stop watch can be used independently. Supplied complete with case and accessories.*

*Write for descriptive Bulletin 1790-EC.*



**The JAGABI SPEED INDICATOR** *is a watch size speed measuring device which adds up the number of revolutions over a period of three (or six) seconds and shows the revolutions per minute without any calculations. Can also be used to measure feet per minute. Available in two models—for low speeds up to 2000 rpm and for all speeds up to 20,000 rpm. Accuracy well within one-half of one per cent.*

**JAGABI HI-SPEED INDICATOR** (*not shown*). *Chronometric type designed for extraordinarily high speeds, operating on the same principle as the Jagabi Speed Indicator. For speeds up to 100,000 rpm.*

*Write for descriptive Bulletin 1505-EC.*

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# It's time to insist on SAFE wiring again

NOT so long ago, material shortages and other emergency demands forced practices on the electrical industry that did not meet code requirements. For example, people got temporary permission to use open wiring, and other less-than-safe systems.

Now that the emergency is past, common sense dictates a return to safe practice. Temporary wiring should be replaced. In new construction, only the best methods should be followed--and in electrical construction "best" means "safest."

REMEMBER that the only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations is a standard-threaded rigid conduit.

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Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector, New York Board of Fire Underwriters, New York, N. Y.
Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

# Questions on the Code

## GRAIN ELEVATORS

**Q.** *In view of existing conditions of wiring material shortages when it is almost impossible to obtain rigid conduit, is there any substitute that might be used for the wiring of grain elevators?*—E.S.

**A.** The Code definitely states that the only wiring method approved for Class 2 Group G locations is rigid conduit with threaded joints. This will be found under Section 5056. Certain inspection authorities have taken the stand that sometimes it is necessary to permit temporary installations which are not in full conformance to Code requirements, and where nonconductive dusts such as found in a grain elevator are present, the hazard occasioned through the use of substitutes for rigid conduit might not be expected to be more than negligible, providing proper care is exercised in guarding against mechanical injury. However, there are no substitutes for the dust-tight devices housing sparking or arcing equipment or for lighting fixtures. In every case this problem is one that must be settled by the local inspection authorities having jurisdiction.—G.R.

## 3 WAY SWITCH SCHEME

**Q.** *I should like to have your opinion on the diagram sketch below. This is a condition I had a couple of years ago in another state and would like to know if you think it would pass inspection.*—H.F.H.

**A.** There are no Code violations in this arrangement as the switching is all done in underground conductors. If any metal-clad raceway or cable is used all of the four travelling wires must be within the armor.—F.N.-M.S.

## PIPE FOR GROUNDING

**Q.** *"The sketch represents an outdoor service installation mounted on a 6 in. by 6 in. post in the yard. Is underground conduit sufficient for ground or is a driven ground required?*—H.G.

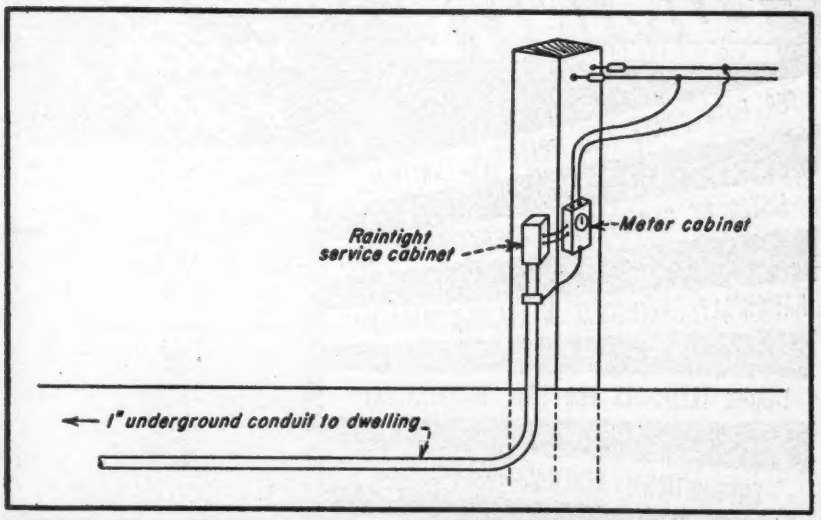
**A.** The Code requires that pipes used as grounding electrodes shall be driven to a depth of at least 8 ft. except where rock bottom is encountered at a depth of at least four feet. The Code further requires that driven ground, if practicable, shall have a resistance to ground of at least 25 ohms and that where it is not as low as that, there shall be two or more electrodes connected in parallel.

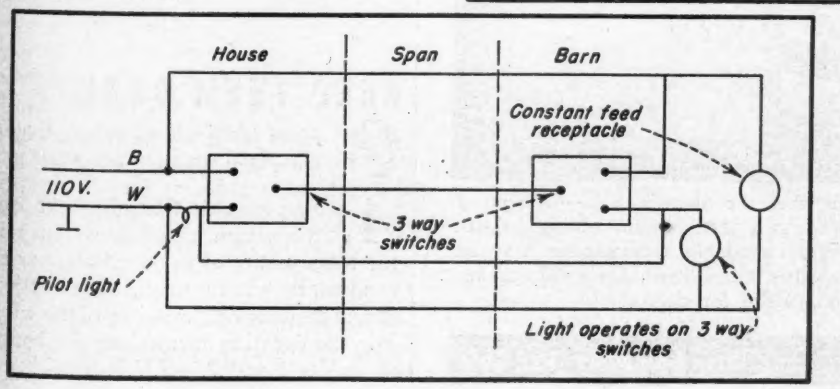
In the case of a yard pole service, driven electrodes should be used, if possible, where a water piping system is not available; but where water pipes are near,—say within 100 to 150 feet—they should, by all means, be used.—F.N.M.S.

## TRIP COIL

**Q.** *Is it true that the 1946 Code will require a trip coil, relay or thermal cutout in each phase conductor supplying a three phase motor?*—D.H.

**A.** No, it was intended to include such a provision in the 1946 Code, but after due deliberation the code committee saw fit to discard this proposal and revert to the provisions contained in the 1940 edition.—G.R.




## A CORRECTION

**Q.** *In the April issue you stated that in a three wire two phase circuit taken from a four wire three phase system the common conductor or neutral will carry 1.41 times the load carried by the phase wire supplying the greater load. May I disagree with this statement and ask you to explain your method of arriving at this answer.*

*My answer to that question would be that the neutral would never carry more current than the ungrounded conductors.*

# A NEW, BETTER BRUSH

AFTER extensive field tests, Speer Carbon Company offers a new carbon brush—grade No. 4029—developed expressly for use on industrial high-speed motors and Diesel-driven generators. Here are the advantages that make this Speer brush outstanding:

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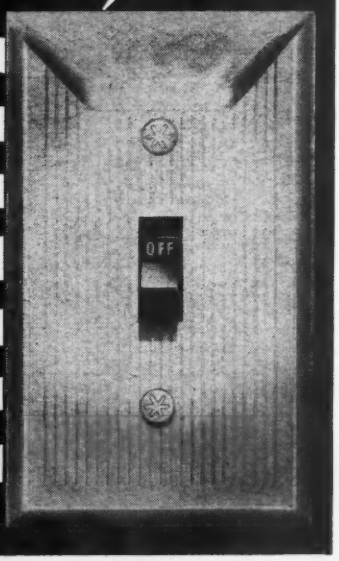


The tiny shielded electric light is *always on* when the room is dark — *always off* when the room lights are on. Ends fumbling for switches. No more smudged walls. Single-gang, two-gang, and multi-gang assemblies available. Operates for less than 2c per year. Works also on 3- and 4-way switches. Guaranteed. For steady profits, sell the *original* LumiNite. List price $1.00. Write for details.

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*In an unbalanced circuit of this type the neutral conductor would carry the load of the lesser loaded conductor plus the difference of the load in the phase conductors added vectorially. Is that not correct?*—M.L.

**A.** Yes your answer is correct. In preparing this question for the April issue an attempt was made to condense the question, as it was quite lengthy and inadvertently I neglected to include the fact that the two phase three wire circuit was obtained from the three phase four wire 440 volt service via a transformer hookup. As a result I have been corrected by many persons that have gone to the trouble of writing and no doubt by countless others that have just wondered.—G.R.

## FARM LIGHTING

**Q.** *On farm jobs where an outside light is wanted in the cattle yard or anywhere else near one of the farm buildings I have been using type SE cable containing an uninsulated neutral between the control switch and the light. Now the new inspector has turned down each job he has visited claiming that the Code is being violated. Is he right?* —J.A.

**A.** Yes the inspector is correct. A cable containing an uninsulated neutral may be used only as permitted by Interim Amendment No. 83 covering Section 3382 of the Code. This section reads as follows:

"Approved service entrance cable types SE and ASE may be used in interior wiring systems if all the conductors of the cable are of the rubber covered type, but if without individual insulation on the grounded conductor may be used only for range and domestic water heater circuits, or as feeders from a master service cabinet to supply other buildings, or as service conductors for such other buildings if the following conditions are met: (a) The cable has a final nonmetallic outer covering. (b) The supply is alternating current not exceeding 150 volts to ground."—G.R.

## KEEP THEM COOL

**Q.** *How far away must conduits be from hot steam pipes?*—G.K.

**A.** Far enough that the heat from the steam pipes does not raise the temperature of the conduits, nor the conductors within them, sufficiently to derate the carrying capacity of the wires. For the derating factors see the bottom of Tables 1 and 2.—F.N.M.S.

## CAPACITY OF SERVICE SWITCH

**Q.** *When laying out a job may the capacity of the service switch in amperes be determined by the actual total connected load less the demand factor?*—E.G.

**A.** Interim Amendment No. 65 as revised on February 10, 1943, reads as follows: "A service switch shall have a rating not less than the load to be carried as determined by Section 2203." Inasmuch as Section 2203 contains the demand factors suitable for various occupancies to be used in computing feeder loads, it is the intent of the Code that these demand factors shall also be used in determining the capacity of the service switch.—G.R.

## FUSING OF TAP

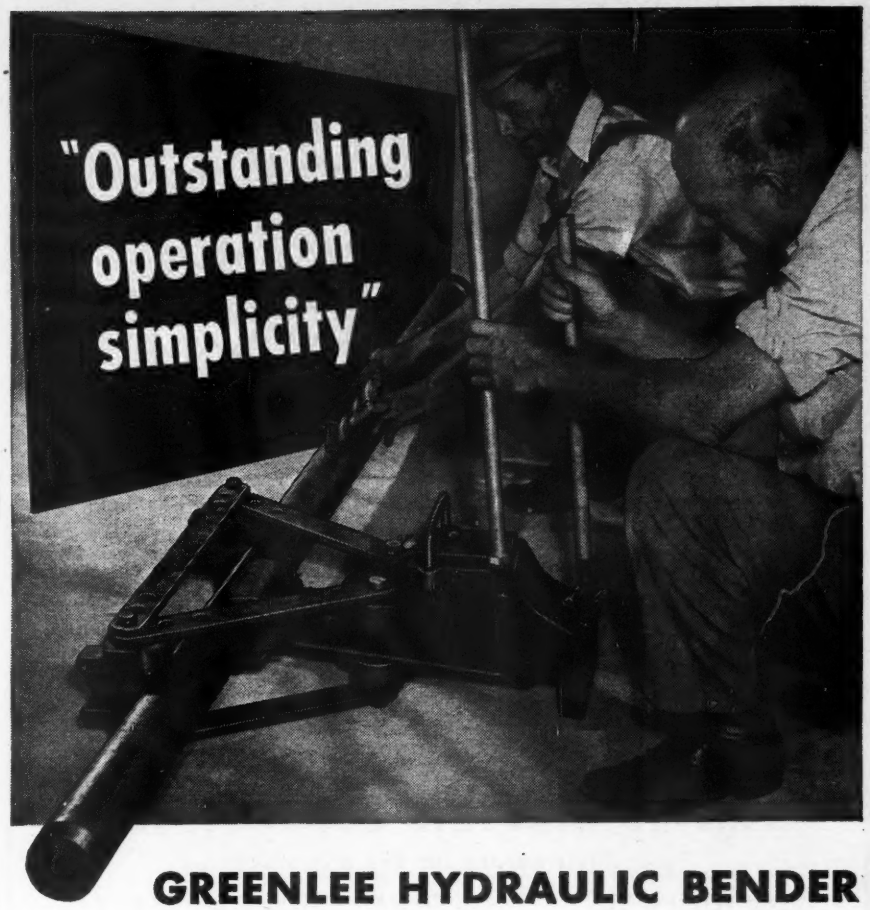
**Q.** *Can we use the one-third capacity of feeder for lighting if not more than 30 feet and not high, and terminating in a lighting cabinet, attached to lighting cabinet bus or must we have main fuses in lighting cabinet?*—G.K.

**A.** A feeder having a capacity of at least ⅓ that of the feeder supplying it, and not over *25* ft. long, may supply a lighting panel but *must* terminate in a single set of fuses (or a single circuit breaker) which would be the main fuse of a panel. These fuses would have to be of the proper size to limit the load on the tap. The tap also would have to be protected from mechanical injury.

For a tap of 30 feet, the protective device would have to be at the point where the tap is made to the feeder or within 25 feet of the tapping point.—F.N.M.S.

## INDUSTRIAL LIGHTING

**Q.** *We plan to bid on a rather large relighting job in a local factory. Plans call for fluorescent fixtures to be hung in continuous troughs suspended some three feet below the open steelwork supporting the roof. The fixtures we plan to use are designed to form a continuous raceway for the circuits supplying them, but we have been told that the Code would not permit wiring within a fixture that was used for purposes other than for the supply of that fixture. Now these rows or troughs will be over 100 feet in length making it necessary to carry several circuits through to supply the load. If we can do that, we can make a substantial saving as the cost of instal-*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"In every respect, our GREENLEE Hydraulic Pipe Bender is *very satisfactory* and its simplicity of operation is outstanding!" Thus reports Southwest Electric Company of Dallas, Texas.

"There is a minimum of spoilage with a GREENLEE Bender and it provides substantial savings on fittings and manufactured bends—*plus important labor savings,*" continues the report.

You, too, will like the "simple as A. B. C. operation" of a GREENLEE. A beginner can quickly learn to use it. And in but a few minutes *one man* can make smooth, precise bends in pipe up to 4½", rigid and *thin-wall* conduit, tubing, bus-bars.

The GREENLEE Hydraulic Bender is compact, portable . . . easy to carry from job to job, set up and operate *when and where wanted.* And, whatever your bending job, there's a GREENLEE Hydraulic or Hand Bender to do it easier, faster, better! Write today for complete information on these timesaving tools. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1747 Herbert Avenue, Rockford, Illinois.

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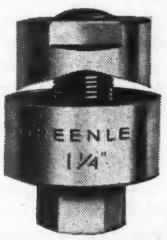


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Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

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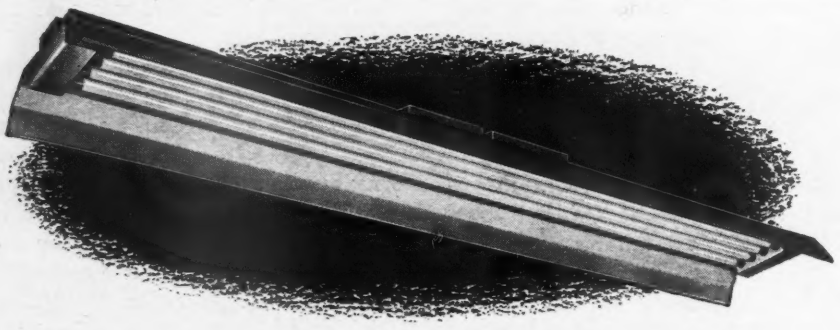

# *COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES

Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and *pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.*

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GENERAL LUMINESCENT CORPORATION

672 S. FEDERAL STREET CHICAGO 5, ILLINOIS


*ling conduit runs above these troughs would be considerable. Would the use of these wireways or raceways as planned be a Code violation?*—E.M.

**A.** There really is no answer to your question in the 1940 Code except for the limitation on ambient temperatures in which various types of conductors may be used. However, the 1946 Code will provide for this type of lighting in the following manner:

"Fixtures shall not be used as a raceway for circuit conductors unless the fixture meets the requirements of approved raceways, except that the conductors of a single branch circuit may be carried through an installation of fixtures approved for end to end assembly to form a continuous raceway. Conductors shall be so arranged that they will not be subject to temperatures above those for which they are approved."

Therefore most fixtures for continuous trough lighting may not be used as raceway for a circuit or circuits which do not supply the fixture.—G.R.

## UNDERFLOOR RACEWAY

**Q.** *Article 354 Paragraph 3543 of the National Electrical Code regarding Underfloor Raceway, states:*

*"Raceways of half-round sections or of flat top section, not over 4 inches in width, shall have at least ¾ in. of concrete or wood above the raceway, except in office occupancies, metal flat top raceways not over 2 inches in width may be laid flush with the concrete if covered with substantial linoleum not less than ⅛ in. in thickness or equivalent floor covering. Flat top raceways over four inches in width and flat top raceways placed less than ½ in. apart, shall be covered with concrete to a depth of at least 1½ in."*

*Would it be within N.E.C. requirements if in office occupancies metal flat top raceways not over 2 inches in width were laid flush in a hard wood floor covered with substantial linoleum of not less than ⅛ in. in thickness?*

*Walker Brothers in their 1944 Underfloor and Conduit Reprint catalogue just recently issued, show on page 33 underfloor duct for flush work for renovating existing buildings. The ducts and junction boxes shown are for 3⅛ in. wide flat top duct and combinations of their 1⅞ in. and 3⅛ in. flat-top ducts by welding these together.*

*Could you tell me just under what conditions these flush system ducts can be used and still be within N.E.C. requirements with respect to flush work?* —H.W.R.

**A.** Section 3542 states that underfloor raceway may be used when installed beneath the surface of concrete

*or other flooring material.* Section 3543 states that in office occupancies, metal flat-top raceways not over two inches in width may be laid flush with the concrete if covered with substantial linoleum not less than $\frac{1}{8}$ in. in thickness or equivalent floor covering.

In all probability where there is a "substantial" linoleum covering not less than $\frac{1}{8}$ in. thick over a hard wood flooring, the raceway could be laid flush with the wood flooring without violating the intent of Section 3543.

Where the raceway is over two inches in width, the present Code requires a covering of concrete but the 1946 Code will permit in office occupancies a metal flat-top raceway not over 4 inches in width used for signal and communication wires and a metal flat-top raceway not over two inches in width used for light and power wires to be laid side by side and flush with the flooring if covered with substantial linoleum not less than $\frac{1}{8}$ in. in thickness if the raceways are spot welded together so as to form a double raceway.—F.N.M.S.

## CONDUCTOR INSULATION

**Q.** *Will you clarify Section 93001, Table on Conductor Insulations, the word "Solid", under Trade Name and under Insulations?*—F.E.H.

**A.** The word "Solid" goes with the other words to typify the type of insulation in that this insulation is a solid mass of synthetic compound without other covering such as a braid.

The same applies to "insulation" in that it is a solid, flame-retardant, moisture-repellent synthetic compound.

The word "solid" in this case does not apply to the copper conductors themselves.—F.N.M.S.

## ISOLATION vs GROUNDING

**Q.** *What is the height for grounding current carrying parts from floor?*—G.K.

**A.** Isolation by height is not a general alternative for grounding. As indicated in Section 2501 it is an alternative only under certain conditions. These certain conditions would have to be ascertained from the inspection bureau having jurisdiction. The only one specifically mentioned seems to be transformers operating over 150 volts to ground, mounted on wooden poles at a height of more than 8 ft. from the ground.—F.N.M.S.


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***Wall or Floor Mounting***
No extra brackets.

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No splicing—No soldering—
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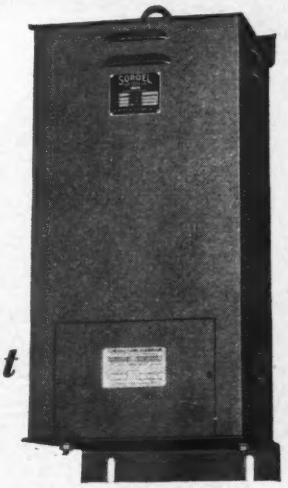
15 KVA. 3-phase,
Wall Mounting Type.

***Interchangeable***
*Single Phase Units*
460 or 230 volt primary.
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All self contained.
No complicated connections.

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For every purpose.

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$\frac{1}{4}$ to 1000 KVA.
All voltages.

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Floor Mounting Type.
With cover of connection compartment
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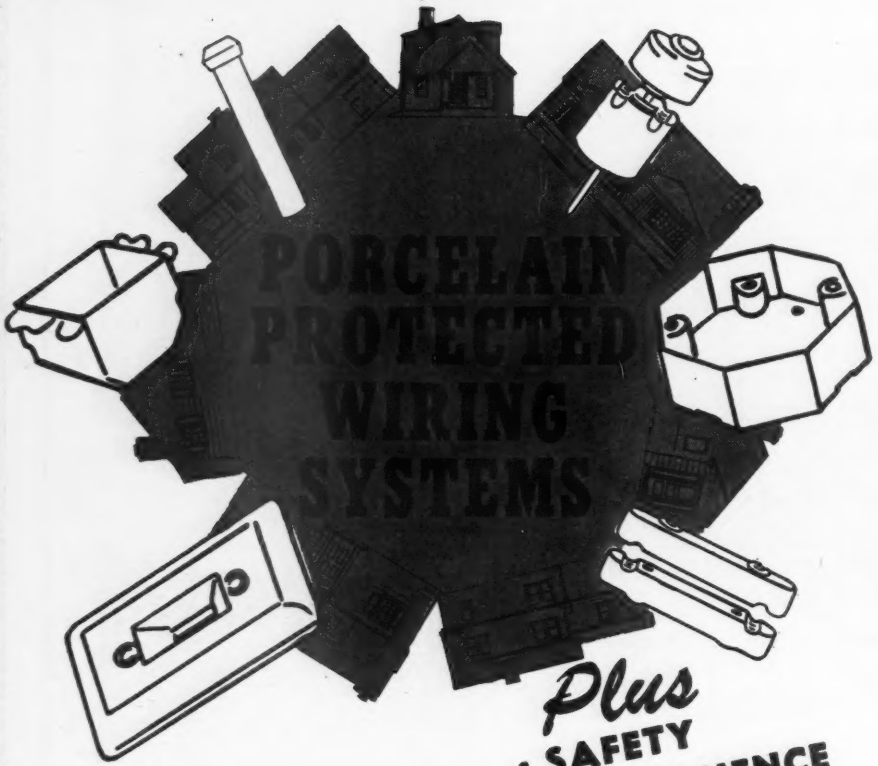


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MORE ATTENTION must be paid to ADEQUACY in home wiring now than ever before. PORCELAIN PROTECTED WIRING SYSTEMS afford a simple, practical, and dependable means for gaining adequacy for the smallest cottage or for the largest home. In addition, you can easily and economically provide for service and feeder capacities to meet future load additions.

The new appliances, apparatus, and lighting components now being manufactured will mean heavier loads. Also there is greater usage of appliances and apparatus as well as more elaborate lighting.

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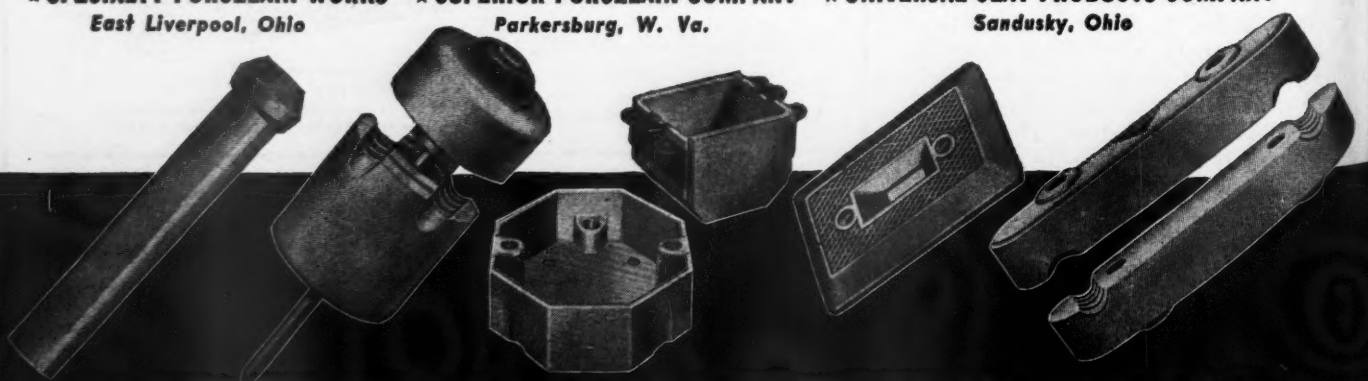

**MODERN PORCELAIN PROTECTED WIRING SYSTEMS**

# In the News

## NEW ERA CONSTRUCTION PROCEDURE ANNOUNCED

A new procedure designed to expedite rural power line construction has been recommended by the Rural Electrification Administration to its cooperatives and other borrowers. The procedure, developed by REA engineers upon recommendation of the borrowers, provides for contractors to bid only on labor required for a construction project. The REA borrower will procure and furnish to the contractor all the materials necessary for the complete job and will not award a contract until sufficient materials are assured for continuous construction.

In announcing development of the new procedure, J. K. O'Shaughnessy, chief of REA's Engineering Division, pointed out that the new procedure will free both REA borrowers and power line construction contractors from the uncertainties of the materials situation without delaying the completion of rural electrification projects. Under this method, the start of some construction work may be delayed. However, REA believes that contractors, working on a mass production schedule with materials available, will be able to complete an entire project at an earlier date than the contractor who starts construction sooner but builds small sections as materials become available. For this reason, the maximum time for completion of a contract has been reduced to 90 days.

Previously, REA borrowers awarded contracts on the basis of bids submitted for both labor and materials. Under this arrangement, it was necessary for the contractor to secure his own materials and build sections of a project as materials became available. Contractors were handicapped under this procedure in making their bids because of the uncertainties of future prices for line construction material.

Mr. O'Shaughnessy predicts that this new procedure will encourage new contractors to enter the rural electrification field and stimulate the present contractors to expand their activities.

Under this new system, he points out, the bonding requirements of a contractor will be reduced since the total amount of each contract will be considerably reduced. Contractors will also benefit as a result of steady work on one project and will lose no revenue because of interruption in work schedules. In the past, some contractors have taken losses because of their failure to complete a project within the required time. With materials assured, REA believes, this difficulty will be minimized.

"That electrical contractor says we're too remote for electrical service, paw. What's remote?"

REA borrowers, it is anticipated, will obtain lower costs and, in some cases, quicker delivery by purchasing materials directly, rather than through contractors. The REA Group Purchase Plan will be used for large orders of such items as meters, transformers, oil circuit breakers and service control equipment. On conductor, poles and other items not available through Group Purchase, the cooperative will place orders directly with the manufacturer or distributor.

The new procedure is also expected to be more satisfactory to new consumers awaiting service from REA borrowers. A new consumer, REA points out, will no longer be uncertain about the completion of construction work in his area and will be able to plan accordingly for farmstead wiring and equipment installation.

While REA recommends that all borrowers adopt this new procedure, approval will be given to other forms of construction contracts when circumstances indicate that the rate of construction and cost will be more satisfactory.

### LABOR ONLY LINE CONSTRUCTION

***An Editorial***

**Installation-only procedure for contracting line construction recommended to the co-ops by REA is described on this page. It is bad public policy. It is bad engineering. It is bad economics. And you and I are paying the bill.**

**The claims that line construction will be expedited are fatuous. It takes experience, skill, know-how, business acumen and time to select, buy, store and distribute electrical materials. By what unique virtue can the co-ops perform these functions more cheaply or more expeditiously than the contractor?**

**What actually happens is a subsidy by service. The use of REA and co-op facilities and personnel for material purchasing and distribution can be absorbed in administration and operations to show a fictitious saving. However uneconomical or grossly inefficient the procedure becomes, your money and mine are on tap to cover.**

**There's nothing sacred about conventional contract procedures. They have, however, stood the test of time, experience, competition and critical accountancy. The "labor only" contract is a notoriously vicious device. REA's recommendation gives the stamp of public approval to a procedure that is clearly opposed to the public interest.**

**When You *Need* COMMUTATORS for those tough jobs—**

Built with Precision from the finest grade of hard drawn silver-bearing copper and mica insulation.
Built for Longer Life—our staff of engineers has had years of "know how" experience in building better commutators—their services are yours for the asking.

*Write or Wire*

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3 FACTORIES TO SERVE YOU
TOLEDO HOMER HILLSDALE

**. . . means better lighting at lower cost!**

Fluor-O-Shields afford keener visibility — minimize stroboscopic effect, diffuse evenly and soften the light of fluorescent lamps. Fluor-O-Shields fit nearly all open-face fluorescent fixtures — 20W and 40W, single and multiple lamp units. Snap-on clips permit instant mounting. Made of lightweight aluminum, finished in white baked enamel. If your distributor does not stock, ask him to write us.

**$1.95** 40 watt 46⅞ in. **$1.25** 20 watt 22⅞ in.

SPECIFICATIONS

| Cat. No. | Length | Fits Lamp | Units Per Pkg. |
|---|---|---|---|
| 27-1-40 | 46⅞ in. | 40 watt | 12 |
| 27-5-40 | 22⅞ in. | 20 watt | 12 |

**Trade Mark — Patent Pending*

FLUOR-O-SHIELD BY CAMFIELD MFG. COMPANY · GRAND HAVEN, MICH.

***W. W. Knapp, (left), Aluminum Company of America, Minneapolis, Minn., discusses material situation with rural line contractors L. H. Ellett, Agutter Electric Co., Seattle, Wash.; and Neil O'Leary, O'Leary & Stotko Company, Hancock, Minn., at recent Chicago meeting of the Rural Electrical Contractors Association.***

## SNYDER HEADS WETHERBEE ELECTRIC

C. D. Snyder, vice-president of Wetherbee Electric Co., Oklahoma City, Okla., was recently elected president and general manager of the electrical contracting firm. Mr. Snyder bought out the interests of G. A. Peer who will remain active with the company for a period of time. No change in company policy or operating personnel was made.

On March 1, R. E. MacDowell became affiliated with the company as chief engineer. "Mac" is a graduate electrical engineer (B.S. in E.E., University of Kansas, 1932) and for six years was head of the Electrical Section, U. S. Engineers at Tulsa, Oklahoma.

## ORGANIZE COUNTY ELECTRICAL GROUP

A group of electrical contractors of Washtenaw County, Michigan (major cities of Ann Arbor and Ypsilanti) recently organized the Washtenaw County Electrical Club. The purpose is to deal more effectively with local labor-management problems, contractor problems, government and GI apprentice training programs.

Officers elected to guide the activities of the new group include: President, Andrew Smith, A. F. Smith & Son, Ypsilanti; secretary-treasurer, T. C. Rohn, Rohn Electric Shop, Ann Arbor.

Jacob Ross and Roy Rice of Ann Arbor, Andrew Smith, Ysilanti, and Thomas Graham (alternate), Ann Arbor, comprise the Apprenticeship and Educational Board. A Public Relations Board consisting of Keith Graham, Carl Ernst, Jacob Ross (alter-

nate) of Ann Arbor and Phelps Crouse of Ypsilanti are planning an advertising program with the local radio station and local newspapers.

## CONTRACTORS ENTER PARTNERSHIP

A new electrical contracting firm, the Industrial Electric Company, is now serving Oklahoma City and surrounding areas. Recently organized through the association of three electrical estimators and construction supervisors Harry Hoch, G. F. Ehrlich and Harry Reeves, the firm has headquarters at 627½ West Second Street, Oklahoma City.

All three partners are veterans in the electrical field, Hoch and Reeves having spent 25 and 19 years respectively with McEldowney & Son; Ehrlich, 20 years with Wetherbee Electric Company—all of Oklahoma City.

## DALLAS ADOPTS NEW ELECTRICAL CODE

The Electrical Code for the City of Dallas was passed the first part of January by the Technical Electrical Committee, with C. L. McClure, chairman Advisory Committee appointed by the Dallas City Council and it was unanimously approved by the Joint Committee, of which George L. Dahl was chairman.

This ordinance is for the safeguarding of property and promoting the welfare of the public; creating the office of Chief Electrical Inspector and prescribing his duties, rights and authority. Also to establish standards for electrical equipment and for its installation and making it unlawful to undertake the installation of electrical equipment without a permit except as otherwise

***Searching for a hard-to-get distribution panel are (L to R) NECA vice-president L. T. Allen, Allen Electric Co., Tulsa, Oklahoma; and Paul E. Ebersole, Frank Adam Electric Company representative in Tulsa.***


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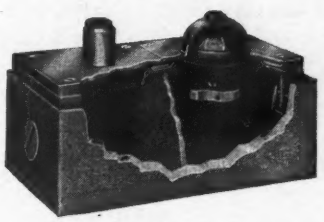
FLOOR BOXES · WIRING SPECIALTIES

**Latrobe Products are Easy to Install and Easy to Sell**

Quick installation means time and labor saved. But the best thing after all about Latrobe Products is their long, efficient service.

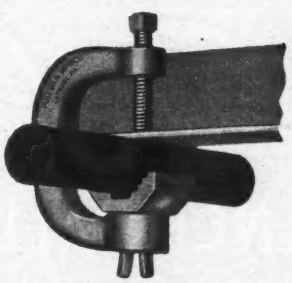
**No. 110 "Latrobe" Watertight Box**

Sturdy iron box with 3½" round Brass Cover Plate. No. 208 Receptacle and No. 207 Ball Nozzle.



**No. 252-R Floor Box**

Here is a Two Gang Box with No. 208 Receptacle in one section. One Cover Plate has ½". Brass Plug and one has 2" Brass Plug.

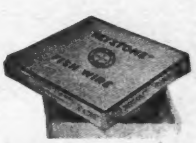


**No. 470 "Latrobe" Pipe or Conduit Hanger**

A most convenient device for hanging pipe or conduit ½", ¾" and 1" to steel beams up to ⅜" thick—or for use as ground clamp.

**"Bull Dog" Insulator Support**

Efficient for fastening porcelain or glass insulators to exposed steel framework.



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Flat and of high quality properly tempered steel.

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ABolite is a name known for many years in the industrial lighting field for reliability, correct design and efficiency.

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REFLECTOR

Standard ABolite reflectors also made in Easy Detachable and Separable Socket types for every kind of industrial lighting.

Floodlights and gas station island lights also available.

ABolite reflectors are made in one of the major plants producing highest quality porcelain-on-steel enameled products.

These durable, easy-to-clean reflector units are made to comply with RLM standard specifications. This label is your assurance of highest quality and dependable performance.

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For the best in industrial lighting, stock, recommend and use ABolite — the old ReliABle.

*Sold exclusively through electrical wholesalers. Order from your regular supplier.*

*Light right with . . .* ABolite REFLECTORS

THE JONES METAL PRODUCTS CO., West Lafayette, Ohio



Specify
ADVANCE BALLASTS
FOR UNEXCELLED PERFORMANCE

Leading manufacturers of lighting fixtures use and recommend "ADVANCE" Ballasts for QUIET operation, high efficiency performance, low replacement cost and long life. "ADVANCE" Ballasts are streamlined for easy installation in fixtures and are approved by Underwriters Laboratories.

ADVANCE TRANSFORMER CO.

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provided. It also provides for the registration of electrical workers and contractors; penalties for the violation of this ordinance; and repealing ordinances in conflict with this new code.

## TULSA ABOLISHES EXAMINING BOARD

The city commission of Tulsa, Oklahoma, abolished the electrical examining board effective March 1. This action followed the formation of a state examining board to issue state licenses for electrical contractors as provided in the Oklahoma State Electrical License and Inspection Law passed last year.

## CPA REPORTS ON CONSTRUCTION

More than half a million inquiries and applications for non-housing construction were handled by Civilian Production Administration during the first eleven weeks' operation of its building control order, OPA Administrator John D. Small reported recently.

Of this flood of requests from persons who wanted to build CPA turned back approximately nine out of ten (450,000) projects before they reached the formal application stage. This was done by persuading the applicants that their projects either were not essential, or that they could be deferred. Of the remaining number, nearly 50,000 who were convinced that their projects were essential and non-deferrable, or where stoppage would have resulted in extreme

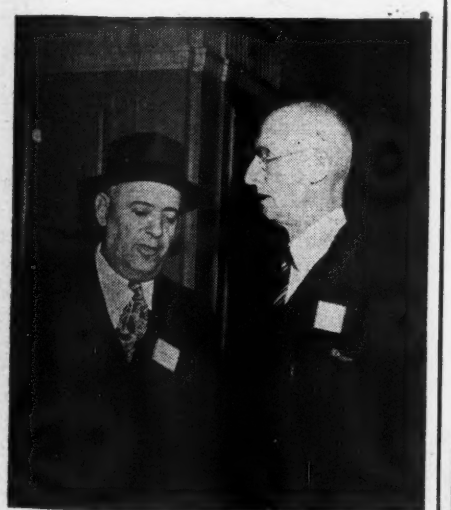
***Large motors like this 200 hp., 3300-volt flour mill motor with a scored stator typify the size of equipment repaired in A. W. White's service shop in Oklahoma City, Okla. White, who grew up with the city, organized the A. W. White Electric Motor and Machine Co. back in 1919; now does about 80 percent of motor and transformer repairs in the area.***

hardship, CPA approved 31,457 and denied 14,971, Mr. Small reported.

CPA recognizes that some industrial and commercial work must go forward, not only to take care of the needs of new communities, but also to provide job opportunities, for veterans who need jobs as well as houses, the report indicated.

Construction cost of the projects approved over the first eleven weeks' period totalled over $1,370,000,000, a going rate for non-housing construction of approximately $6.5 billion annually. This is a very small fraction of the cost of the 450,000 projects that would have gone ahead, had there been no order, Mr. Small said.

During the first month after issuance of the Veterans Housing Program Order I, on March 26, 1946, CPA received a flood of applications for projects which were ready to get under way. In most instances, facts indicated that denial of these applications would result in serious hardship. Many of these applications covered building projects on which such and amount of money had been committed in materiasl purchases and engineering preparation that refusal to approve the project would have imposed an extreme hardship, resulting in bankruptcy in some cases. CPA was lenient with such cases, but once the peak of hardship cases had been processed, dollar value of approvals has dropped week by week, with value of denial increasing steadily. This has been necessary, Mr. Small's report indicates, to prevent the total authorization of construction by the National Housing Agency and CPA authorizations from outrunning the supply of building materials, substantially reduced by strikes.



***Eastern contractors W. V. Pangborne Philadelphia; and John L. Flagg, Watson-Flagg Engineering Company, New York City discuss the postwar electrical construction possibilities.***


Monarch Fuse
SPRING CLIPS

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*Prevent Fuse Failures Due to Terminal Heating*

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Monarch DOUBLE END WRENCH

Users of Monarch Renewable Fuses are provided with this ingenious wrench . . . designed to fit nuts on any and all sizes of our fuses.

MONARCH FUSES Are Available Through RECOGNIZED WHOLESALERS

*Specify* Monarch Fuses *for improved*

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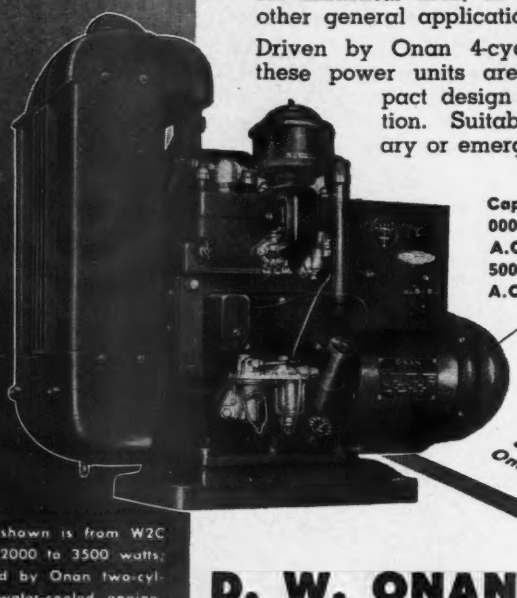
# Electricity

## FOR ANY JOB—ANYWHERE

Onan ELECTRIC PLANTS

ONAN ELECTRIC GENERATING PLANTS supply reliable, economical electric service for industrial uses, as well as for scores of other general applications.

Driven by Onan 4-cycle gasoline engines, these power units are of single-unit, compact design and sturdy construction. Suitable for mobile, stationary or emergency service.



Capacity range: 350 to 35,000 watts; 115 to 660 volts A.C., 50 to 800 cycles; 6 to 500 volts D.C.; combination A.C.—D.C. types.

Write For Folder 690 describing complete Onan Line

Model shown is from W2C series: 2000 to 3500 watts, powered by Onan two-cylinder, water-cooled engine.

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GUTH Germ-Killing Lights provide you with one of the best profit-building opportunities in the whole industry! Every school, office, restaurant, and public building—as well as dairy, horse and poultry farms, food processors, meat markets, etc., are *all* potential buyers.

We have pioneered in designing and building *Germ-Killing Lights*, and our experienced engineering service is bound to help make selling easier for you.

Write today for detailed Bulletins on GUTH Germ-Killing Lights. They are packed with real, usable information to help you sell.

**GUTH GERM-KILLING LIGHTS**

*Work More Effectively than a Surgeon's Mask*

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The Edwin F. Guth Co. • 2615 Washington Ave. • St. Louis 3, Mo.

***J. N. Townsend, (left) Townsend Electric Co., Jackson, Tenn.; and C. L. Jacobs, Jacobs & Doyle Construction Co., Edgewood, Iowa, air REA policies at recent organization meeting of the Rural Electrical Contractors Association in Chicago.***

## COPPER WIRE INDUSTRY MEETS WITH CPA

The Copper Wire and Cable Mill Industry Advisory Committee has recommended that, with a few stated exceptions, all copper wire bars should be sold only to wire manufacturers, the Civilian Production Administration reported recently. The committee, which met at the request of industry members, said this procedure would follow the pattern used by the War Production Board during the war years.

Committee members reported that some users of magnet wire had received finished wire products from manufacturers and also wire bars from the Reconstruction Finance Corporation's Metals Reserve stockpile. The proposal to channel all copper wire bars to wire manufacturers, the committee said, would eliminate such duplication and permit an equitable distribution of wire based on the users' past consumption.

CPA officials said that the committee's plan would be studied carefully.

Copper wire of various sizes is an essential item in the Veterans' Housing Program, it was stated by CPA, and industry must make every effort to meet the requirements. Both CPA and committee members agreed that shortages of copper, cotton yarn, rubber, synthetic rubber and plastics increased the problems of copper wire and cable production.

Strikes have closed some plants for as long as five months, affecting production to such an extent that at least a 60 to 90-day lag may occur between the reopening of these mills and the arrival of finished products on the market, the agency said.

CPA had previously estimated that with all facilities operating, domestic production would be approximately 70,000 tons per month, with the demand

greatly in excess of this amount. Consequently, the public purchase program instituted in the first half of 1946 must be continued during the last half of the year, contingent upon Congress' passing the necessary legislation. The Metals Reserve stocks of copper are now deficient in the particular shapes, such as wire bars, which are in greatest demand.

Reasons for the decreased rate of production of copper were summarized by CPA officials as neglect of mine exploration and development work during the war years and labor problems of all kinds.

CPA said that copper imports could not be increased because no contracts could be signed for such imports until Congress passes the legislation which includes the copper subsidy program. When the subsidy powers are extended, new contracts will be let for copper imports. (Large producers are located in Rhodesia, Belgian Congo, Australia, Canada, South America and Russia.)

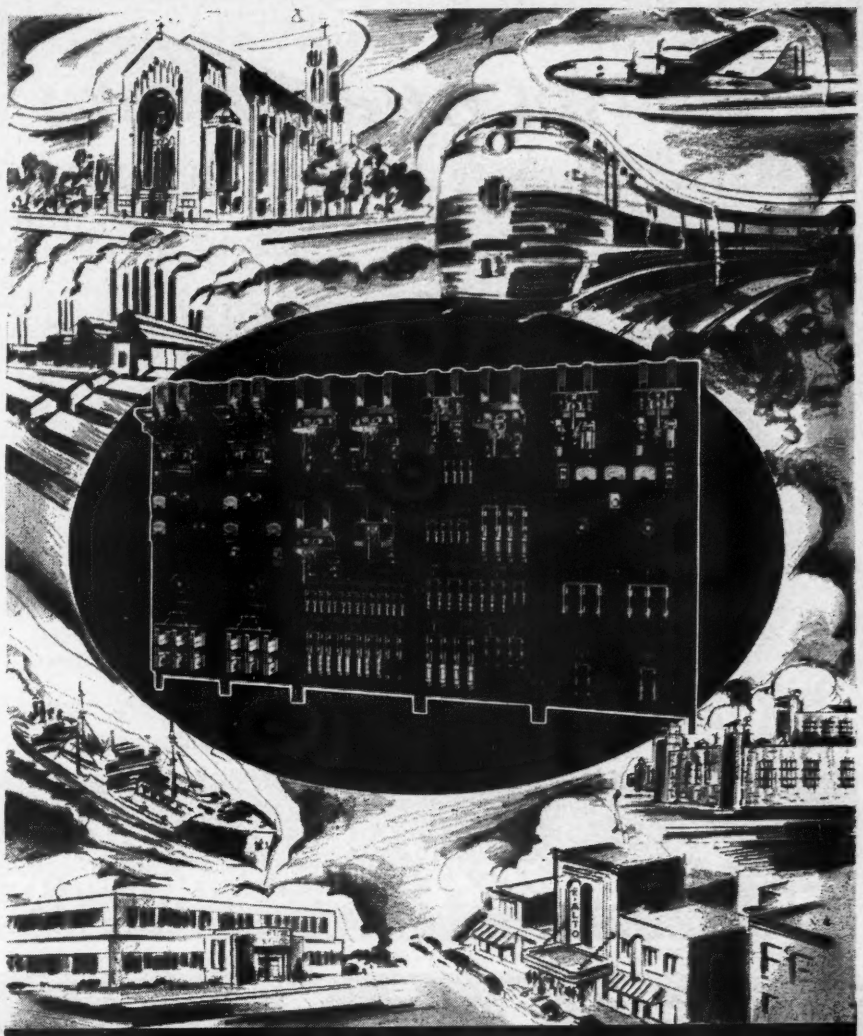
The committee recommended an increase lead allotment to the cable industry. CPA officials said that the estimated lead supply will take care of about 80 percent of the restricted demands of the cable industry.

Cotton yarn and plastic used in the wire industry are also very short. CPA will shortly send industry members a questionnaire on their needs and present stocks of cotton yarn and sheeting (used for cable tapes).

With this information, CPA will try to channel the necessary amounts to fill manufacturing requirements, officials said. A similar investigation will be made by CPA on the question of plastic material which is used in the making of polyvinylchloride (used as an insulating material).

---

***"Put it in writing" is the business slogan of Frank Ecton, owner of the Ecton Electric Co., Tulsa, Oklahoma contracting firm. Frank has developed a pocket-size pad of contract forms that come in mighty handy for small "odd" jobs. Forms clearly state terms of contract, work to be done, price and space for his and customer's signatures.***

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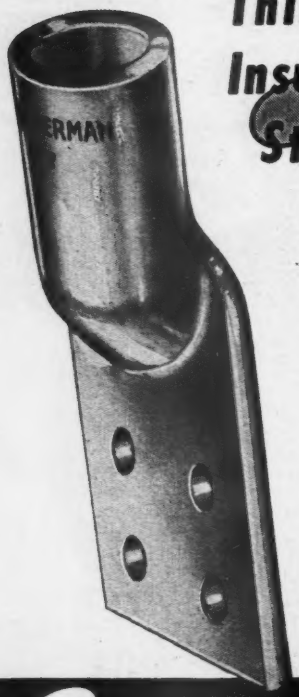
**PELHAM ELECTRIC MANUFACTURING CORP., ERIE, PA.**

SPECIALIZED DESIGN

Pelham

UNEXCELLED QUALITY

SWITCHBOARDS • PANEL BOARDS • SWITCH GEAR AND ACCESSORIES



**This Extra Deep Socket Insures Greater Mechanical Strength plus Higher Conductivity**

**Extra strength, to withstand any stresses — plus extra capacity to insure minimum IR drop! That's the combination that has made these Sherman Soldering Lugs the standard of the electrical industry.**

**Sherman Lugs are bright and clean, too, with no sharp edges or burrs — and the contact surfaces are FLAT.**

**Write for catalog which gives full specifications on a wide range of sizes and styles.**

**H. B. SHERMAN MFG. CO.**
**BATTLE CREEK, MICHIGAN**

**Sherman HEAVY DUTY SOLDERING LUGS**

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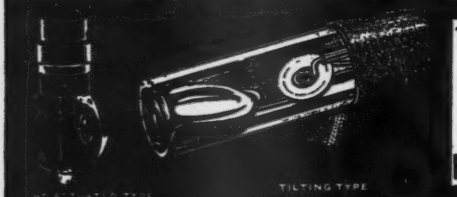

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*Pressure Control*

Designed to automatically regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement.

Mercoid Controls have many desirable features which have made them favorites among leading industrial engineers.

*Temperature Control in Explosion-proof case*

DA (Double Adjustment) Temperature or Pressure Controls are used extensively on industrial applications. The outside double adjustment facilitates the control operating range setting. The calibrated dial plainly indicates the desired setting. All guesswork is eliminated. No cover to open or remove when making control adjustments. A locking device is provided to prevent tampering. Various ranges available.

The hermetically sealed mercury switches are dust and corrosion-proof. There is no open arcing, pitting or sticking of contacts. These switches assure better control performance and longer control life.

If you have a pressure or temperature control problem Mercoid engineers will assist you.

See catalog No. 600 for complete information on all types of Mercoid Controls.

THE MERCOID CORPORATION, 4225 BELMONT AVE., CHICAGO 41, ILLINOIS


## PHARES BROTHERS OPEN REPAIR FIRM

Available to industrials and utilities in Oklahoma City and surrounding areas will be the services of the Southwest Electric Company, a new electric equipment repair firm recently organized by the three Phares brothers—James A., C. Arthur, and George E.

Headquartered in a large, new building at 2617 S. Agnew St. in Oklahoma City, the firm is now ready to repair electric control equipment, motors, generators and transformers of all types and sizes. Some indication of the size of equipment they are prepared to handle is given by the 8-ft. by 8-ft. by 10-ft. walk-in bake oven, the 6-ft. by 12-ft. vacuum tank, and the large transformer coil winding lathes they have designed and installed in their new shop.

James A. Phares is the general manager and sales engineer. Arthur is in charge of motor repairs and George supervises the transformer repairs.

## BURNETT HEADS NECA CHICAGO CHAPTER

Oliver F. Burnett, Jr., Kelso-Burnett Electric Co., was elected president of the Electrical Contractors Association of City of Chicago (NECA Chapter) at a recent meeting of that group. Burnett fills the vacancy created by the retirement of Wm. McGuineas of the United Electric Construction Company. J. Walter Collins is secretary-treasurer.

Members of the executive committee are: J. M. Hoffman, A. C. McWilliams, E. E. Leasure, J. N. Pierce, F. E. Vogel, L. W. Johnson, and O. F. Burnett, Jr.

***C. S. Kidd (left), sales engineer, Allen Bradley Co., explains zero speed switch operation to Allis-Chalmers electrical draftsmen H. E. Rogosch and E. A. Janssen at Milwaukee EME Industrial Electrical Exposition.***

*On the shoulders of R. M. Hanselman, plant engineering division, Kaiser-Frazer Corporation rests a good share of the engineering responsibilities connected with the huge task of reconverting the Willow Run Bomber Plant from aircraft to automotive production.*

# DATES AHEAD

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Colo., July 9.

**Southern California Construction Industries**—Exhibition and Home Show—Pan-Pacific Auditorium, Los Angeles, Cal., July 12–21.

**Pacific Coast Convention—AIEE**—Seattle, Wash., August 26 to 31.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., August 13.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., September 10.

**Illuminating Engineering Society**—National Convention—Chateau Frontenac, Quebec, Canada, September 18–21.

**Omaha Electric Show**—Sponsored by the Nebraska and Western Iowa Chapter, NECA, Omaha, Nebr., September 23–28.

**International Association of Electrical Inspectors**—Northwestern Section, Hotel Boise, Boise City, Idaho, Sept. 23–25; Southwestern Section, Hotel Sacramento, Sacramento, Calif., Sept. 30–Oct. 2; Southern Section, Asheville, N. C., Oct. 14–16; Western Section, Gibson Hotel, Cincinnati, Ohio, Oct. 21–23; Eastern Section, Mark Twain Hotel, Elmira, N. Y., Oct. 28–30.

**National Electronics Conference**—Edgewater Beach Hotel, Chicago, Ill., October 3–5.

**National Safety Congress**—Hotels Stevens, Congress & Palmer House, Chicago, Ill. Week of October 7.

**Rocky Mt. Chap.—IAEI**—City and County Bldg., Denver, Col., October 8.

**International Municipal Signal Association, Inc.**—Annual Meeting—Miami Colonial Hotel, Miami, Fla., October 14 to 17.

**National Electrical Contractors Association**—Annual Meeting, Ritz Carlton Hotel, Atlantic City, N. J., Oct. 14–18.

**National Electrical Manufacturers Association**—Annual Meeting—Marlboro-Blenheim and Claridge Hotels, Atlantic City, N. J., October 28 to November 2.

**All Industry Refrigeration and Air Conditioning Exposition**—Public Auditorium, Cleveland, Ohio, Oct. 29–Nov. 1.


## Available Now! These Repair Parts Fit MILLIONS of MOTORS

## Every Repairman needs this Handy "On-the-Job" Assortment of Wagner Motor Repair Parts

Be a "One Tripper"—carry this kit in your car for "on-the-job" motor repairs.

It contains fast-moving parts for repulsion-start induction brush-lifting and capacitor-start induction-run motors—up to and including ½ hp.

Order for each of your men. Use coupon below. Also available at 325 authorized service stations.

Wagner Electric Corporation
6413 Plymouth Avenue
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Gentlemen:

Please ship_____ (Quantity) Motor Parts Assortment M-1 at $8.57 each (Net) total $_____.

☐ Also send copy of Motor Parts Catalog MU-40

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Wagner WE Electric

# RELIANCE AUTOMATIC TIME SWITCHES

## Model "W"

Completely automatic . . . extremely simple, compact, economical . . . three types cover practically every requirement . . .

### ASTRONOMIC TIME SWITCH

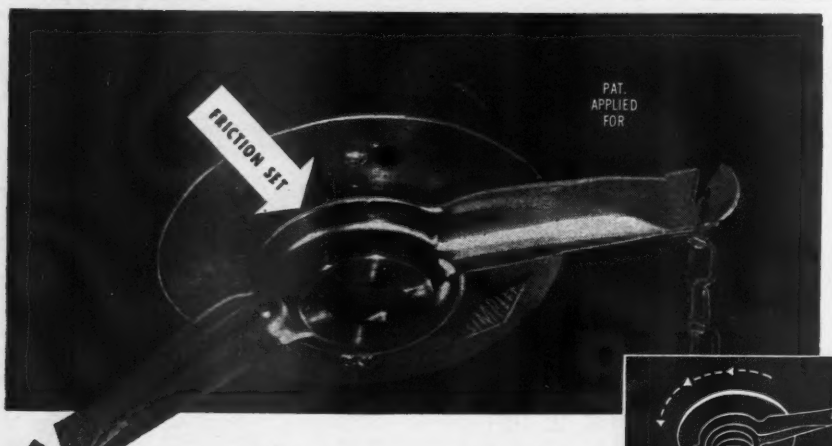
• The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of re-setting the dial as the days become longer or shorter.

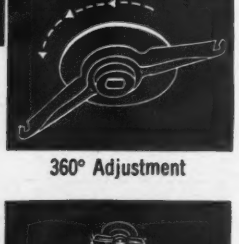
## AMERICA'S RELIABLE 24 hour-a-day GUARDIANS

RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

**RELIANCE AUTOMATIC LIGHTING CO.**

1907 MEAD STREET — RACINE, WISCONSIN



360° Adjustment

## NEW "Friction-Set" FIXTURE HANGER . . .

*That Adjust With a Twist of the Wrist!*

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3¼" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.

**Friction-Set K100 . . . List Price $1.10**

For any fixture position

**SIMPLET ELECTRIC COMPANY**

123 N. Sangamon Street • Chicago 7, Illinois
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# Manufacturers News

## BERT HOLUB ORGANIZES HOLUB INDUSTRIES, INC.

Holub Industries, Inc. is the name of a new manufacturing industry started in Sycamore, Ill., by Bert Holub, who recently resigned as sales manager of the Ideal Commutator Dresser Co. Mr. Holub has purchased a two story cement block building at 413 DeKalb Avenue. He will manufacture electric blowers, industrial cleaners, carbon brush seaters, commutator saws and cutters, stones, wire connectors, fuse clip clamps, pullers, reducers, live centers, electric testers and wire strippers.

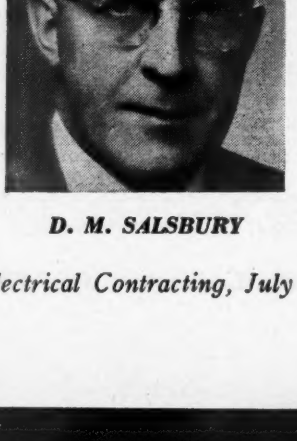
## JEFFERSON ELECTRIC CHANGES

Lt. J. M. Bennan has returned to the Jefferson Electric Company, Bellwood, Ill., after about two years service in the Navy. He has been appointed vice president-secretary and has been assigned to other corporate executive duties. In his new position, he will continue to act in an advisory capacity to the Sales Department.

R. A. Hoagland, who served as acting sales manager for the company during Lt. Bennan's absence, has now been made vice president and general sales manager.

## WESCO APPOINTS SALSBURY EXECUTIVE VICE PRESIDENT

The appointment of David M. Salsbury as executive vice president of the Westinghouse Electric Supply Company has been announced. Mr. Salsbury, formerly vice president and general



*D. M. SALSBURY*

manager of the company, succeeds Walter Williamson, who has retired.

Mr. Salsbury, a native of Belleville, Ont., has been in the electric supply business since 1915, when he joined the Northern Electric Company at Calgary, Canada. In 1918, after working for electric companies in Oakland and Fresno, Calif., he joined the Electric Railway & Manufacturer's Supply Company in San Francisco. This company was acquired by Westinghouse in 1920.

Subsequently, Mr. Salsbury served as branch manager in the Supply Company's Salt Lake City office until he was made manager of the North Pacific district with headquarters at Seattle, Wash. He was appointed general manager of the Supply Company in 1943, and the following year was elected vice president.

## T. W. ROLPH HEADS HOLOPHANE COMPANY

Thomas W. Rolph was elected president of the Holophane Company, Inc. Mr. Rolph assumed his new duties July first and is located at the company's

*T. W. ROLPH*

headquarters in New York City. He succeeds Charles Franck, who becomes chairman of the board.

Mr. Rolph has been associated with the Holophane organization for 25 years, first as head of the street lighting department, then chief engineer. Several years ago he was made vice president and was placed in charge of manufacturing and engineering. A year ago he was elected to the board of directors.

## WESTINGHOUSE CHANGES

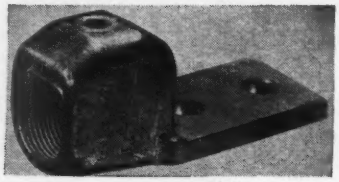
Combining of the Sterilamp and Tenderay sections at the Westinghouse Lamp Division of the Westinghouse Electric Corp., into the Sterilamp-Tenderay department under Charles W. Flood, Jr., as manager, has been announced.

Mr. Flood has been manager of the Sterilamp department for the past four years, supervising the company's activities in the bactericidal ultraviolet field. Louis J. Menges, former manager of

IT's New!
The ROYAL-NOARK RENEWABLE FUSE...
GREATEST ADVANCEMENT IN FUSE DESIGN IN THE INDUSTRY'S HISTORY!
Write for details
ROYAL ELECTRIC COMPANY, INC.
PAWTUCKET • RHODE ISLAND
...you can even assemble it with your eyes closed!

Frankel

RANGE LUG



- Seven sizes of RANGE LUGS connect cables ranging in sizes from 1,000,000 CM to No. 8 wire.
- Cast of electrical bronze, FRANKEL RANGE LUGS embody high strength, compactness and excellent electrical characteristics, and are Underwriter approved.
- RANGE LUGS can also be supplied as 45° and 90° angle lugs.
- RANGE LUGS can be furnished for two, three, and more cables in straight as well as 45° and 90° angle lugs. These are called MULTI-RANGE LUGS.

*Illustrated Bulletin listing sizes, cable ranges and prices mailed upon request.*

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MULTI

A COMPLETE LINE FOR ALL NEEDS

We can supply all your commercial, industrial, and residential lighting needs . . . install the best possible lighting for your customers and make every lighting job pay—guarantee every lighting job you install with MULTI units. This is the modern method for taking good care of your customers and relieving yourself of after worries.

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ELECTRICAL MANUFACTURING CO.
4223 W. Lake St., CHICAGO 24, ILL.

YOU CAN'T MISS WITH Revere Quality

*Scoring "bulls-eyes" consistently, the complete Revere line of lighting equipment scores with your customers.*

Easy to wire — easy to maintain with many exclusive features — Revere units meet every requirement—BETTER!

4200 Series. Enclosed type flood for sports and other wide area lighting. Rotates in yoke for EASY safe maintenance.

QUALITY COUNTS!

REVERE HINGED POLE
Services floodlights from the ground. Clean, working reflectors at all times. 20-24-30 ft. mounting heights. SAFE —no climbing.

3800 Series REVERE ELIPTOR Gives effective uniform lighting. Ingeniously designed.

RELY ON REVERE for all lighting requirements—

REVERE ELECTRIC MFG. CO.
6017 Broadway — Chicago 40, Ill.

the Tenderay licensing section, resigned recently to open a Montclair, N. J. office as an architect and consulting engineer for meat packing houses and allied industries.

Harold C. Hickock has been named central district manager of the B. F. Sturtevant Company Division of Westinghouse Electric Corp., with headquarters in Pittsburgh.

## U.S. RUBBER APPOINTMENTS

Dr. Sidney M. Cadwell has been appointed director of research and technical development of United States Rubber Company. Formerly assistant general manager of the company's tire division, Dr. Cadwell brings to his new position 27 years of administrative and scientific experience in the fields of rubber and plastics.

A. A. Wilcox has been named manager of jobbing sales in the wire and cable department. He was formerly manager of industrial relations and industrial engineering in the company's wire manufacturing plant at Bristol, R. I.

## GRAYBAR APPOINTMENTS

John R. West has been appointed to the position of Wolverine District merchandising manager of the Graybar Electric Company. He will make his office at district headquarters in Detroit.

C. H. McClean has been named northern district manager and will be located at district headquarters in Minneapolis. He replaces E. C. Sharpe, who is retiring after 34 years of service.

Walter Frazier has been appointed midwestern district manager with headquarteres at Kansas City. He succeeds Mr. McClean.

## G-E APPOINTMENTS

Appointment of George P. Lehmann to the newly created post of assistant manager of the General Electric Plastics Divisions has been announced. A former colonel in the 12th Air Force Service Command, Mr. Lehmann has been staff assistant to the manager of the Plastics Divisions since his return from service last fall.

Karl H. Keller, formerly East Central district control and electronics specialist for G-E's apparatus department, has been named manager of the Akron office. Mr. Keller succeeds G. R. Barclay, who has been manager of both the Akron and Canton offices, but who is relinquishing his Akron responsibilities because of the increasing demands on his time in the Canton territory.

Three new appliance and construction

materials manufacturing plants have been leased by G-E's Appliance & Merchandise Department. They are located at Saugerties, N. Y., Coxsackie, N. Y. and Dallas, Texas.

The General Electric Company has purchased the 58,000 square foot factory it has been leasing in Lowell, Mass., since 1944.

General Electric Credit Corporation has opened its Raleigh, N. C., office, located at 304 South Salisbury St. John L. Hoffman has been appointed manager.

GECC has re-opened its Milwaukee, Wis. and Baltimore, Md. office. Glenn A. Davis is manager of the Milwaukee office, located at 207 E. Michigan Street. Richard Cannon is in charge of the Baltimore office at 7 East 21st Street.

## PARAGON ELECTRIC CHANGES

Paragon Electric Company announces the consolidation of its main office, formerly in Chicago, with its factory at Two Rivers, Wis. A district sales office will remain at 37 West Van Buren Street, Chicago.

E. V. Platt, for many years executive vice president, has been elected president and continues as general manager.

## ILG SALES STAFF INCREASED

Additions to the sales engineering staff in four branch offices of the Ilg Electric Ventilating Co. have been announced.

G. K. Wood has been appointed manager of the branch in Columbus, Ohio. A. B. Davis has been assigned to the office in Charleston, W. Va. Carl E. Brock, Jr., former Lt. Comdr. in the U. S. Navy, has joined the Pittsburgh branch. Frank Taylor has been assigned to the New Orleans branch.

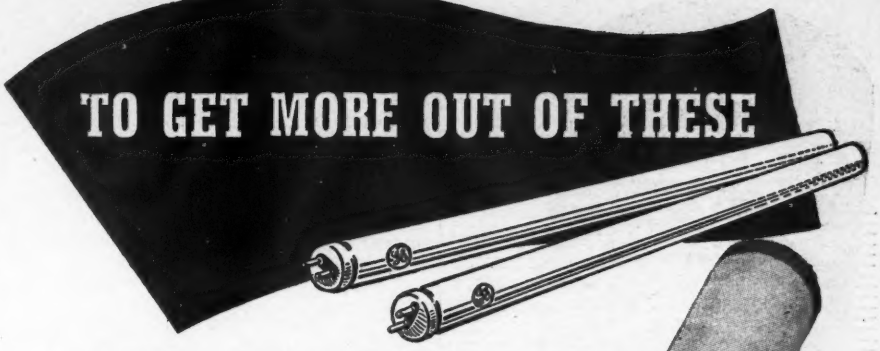
•

**Mastercraft Electric Company, Inc.** has moved to a new plant at 181 Bruce St., Newark 3, N. J. General offices will be located in the plant. Jack Lasser, president, will have complete charge of production, Irving Skolnick, vice president, will be in charge of sales and market research, and Sidney Blackman will direct all phases of purchasing.

•

**The Reliance Electric & Engineering Co.** has named C. V. Gregory as district manager in Pittsburgh. He succeeds Bon J. Ballard, who becomes assistant to the sales vice president. L. J. Carr, who prior to two and one half years in the U. S. Naval Reserve was a sales engineer in Reliance's Chicago office, will join the staff in Pittsburgh.


TO GET MORE OUT OF THESE



...BACK 'EM UP WITH ALL THESE

**WATCH DOG* STARTERS**

Here's the starter for fluorescent lamps that eliminates *blink and flicker.* A "cut out" opens the circuit when lamps reach the end of their useful life. Outlasts ordinary starters 5 to 1. Simplifies maintenance and relamping. Types for lamps from 15-to 100-watts.

**ROTATING LOCK LAMPHOLDERS**

Among G.E.'s full line of lampholders for fluorescent fixtures, this is the most popular type. When lamps are inserted and rotated, they *lock* into place. Made in white or black plastic in mounting combinations to meet the needs of any standard fixture.

**TWIN TURRET LAMPHOLDERS**

A strong, practical support for two 40-watt lamps and starter. Each lamp is inserted by depressing either face of holder until lamp end snaps into position. Twin Turret Lampholders are easily mounted on any flat surface.

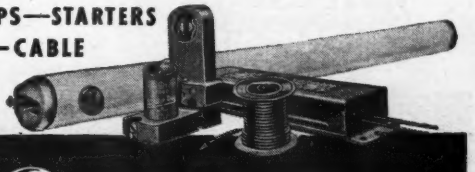
**SLIMLINE LAMPHOLDERS**

These white plastic lampholders are styled and finished for modern fluorescent fixture lighting with the new Slimline Lamps. Lamps are easily inserted, firmly held. Companion types are particularly suited for narrow channel mounting.

*Trade-mark Reg. U. S. Pat. Off.

*For information on these and other G-E accessories for fluorescent lighting (including the new Circline accessories), write Section G1-7-8, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.*

BALLASTS—LAMPS—STARTERS
LAMPHOLDERS—CABLE
*for dependability in fluorescent lighting*



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# It does the job...

● **The latest Aerovox catalog lists both exact-duplicate and universal types of motor-starting capacitor replacements. Select the type you prefer. Get it from your Aerovox supplier. Install it. Forget it.**

**You'll make a handsome profit—and keep it—because there are no comebacks when you install Aerovox capacitors. Therefore, ask your Aerovox supplier for our latest catalog—or write us.**

AEROVOX capacitors

FOR RADIO-ELECTRONIC AND INDUSTRIAL APPLICATIONS

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R. N. Landreth, assistant to the vice president, General Machinery Division, of the **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis., has been named to direct the activities of the company's Washington, D. C., district office in addition to his other special duties.

Ralph Newquist has resigned as manager of the Washington district office to accept a position in charge of sales for a mid-western concern.

•

**Day-Brite Lighting, Inc.** of St. Louis has announced the appointment of E. B. Bomar as sales representative with headquarters at 622 N. First St., Phoenix, Ariz. Prior to joining Day-Brite, Mr. Bomar served in the capacity of sales engineer for the J. E. Redmond Co. of Phoenix.

•

**Cutler-Hammer, Inc.** announces the opening of a new office in Rockford, Ill., at 1404 North Main St. The office will be in charge of G. I. Wolff, who has handled the territory for 19 years. R. E. Ford, who has been in the Milwaukee sales organization for five years, will be resident sales engineer.

•

**The Tal Prestal Bender, Inc.**, of Milwaukee, Wis. has moved into larger quarters at 417 North Water Street.

•

Dan J. Connor Co., Real Estate Trust Bldg., Philadelphia, Pa., has been appointed to represent **The Insl-x Co., Inc.** in Eastern Pennsylvania, Southern New Jersey, Eastern Maryland and Washington, D. C.

•

**Feedrail Corporation,** New York City, has announced the appointment of Samuel G. Boyd as its agent for Georgia, Alabama, South Carolina and eastern Tennessee. Mr. Boyd's office is in the Walton Building, Atlanta, Ga.

•

**The Edwin L. Wiegand Co.,** Pittsburgh, Pa. is building a new plant to expand facilities for the manufacture of Chromalox electric range units and electric heaters for industry.

•

**General Controls Company,** Glendale, Calif. has named F. E. Weldon and A. C. Kelterborn to the New York factory branch sales staff.


# It's YOUR future—Make the most of it!

## Start now to earn the bigger pay in electrical repair

**Was there ever such an opportunity to get started in electrical maintenance and repair—and at top-notch wages? Are you ready—with experience and ability—to cash in on it? Others are getting just the sort of background needed—quick! practical!—to handle the great variety of electrical maintenance and repair work TODAY—from this well-known electrical library. You can too!**

## Electrical Maintenance and Repair Library

**5 volumes, 2042 pages, 1721 illustrations**

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings—to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

*Includes trouble-shooting book*

Now in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

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## FLUORESCENT MAINTENANCE SERVICE

[FROM PAGE 51]

chanics' time, and material used, and turns this in to the bookkeeper. The bookkeeper attaches the Mechanics Record, and Time and Material form from the mechanic to the Office Record sheet, and files.

Payroll information is taken from the file copies of forms turned in, and all copies of forms are then sent to the manager for pricing. After the job has been priced, the file is sent to the posting clerk, who establishes a customer's ledger account and posts all data. Bills are rendered monthly from customer's ledger, based on the terms of the Maintenance Agreement.

When a contract comes in, a duplicate index card is made and given to the manager. This file gives the manager a ready reference for analysis of his operation.

### Equipment

The division now operates two half-ton panel trucks. Each is completely equipped with test instruments, lamps, lampholders, starters, ballasts, buckets, cleaning equipment, ladders, etc., so that its two-man crew can handle an initial clean-up job from the truck. Plans are under way for summer and winter uniforms for the mechanics. It is believed this will help give mechanics ready access to a customer's premises, add dignity, and help to advertise the service.

A third truck is now available, from the Electrical Contracting Division of the Company, in case of emergency. Plans are also under way to provide another fully equipped truck for full time use, which will also require adding and training two new mechanics.

### Operation

The operation of this fluorescent maintenance service is simple. Experienced lighting maintenance men sell the service. The division is properly managed, made easy through proper organization of all detail work. Trained union maintenance men give prompt and efficient service on the initial clean-up job, on regularly scheduled periodic cleaning, and on emergency calls from customers between periodic cleanings. Emergency calls are now answered within two hours of the time the call is received. Addition of another truck and two-man crew will improve the speed with which such calls are handled.

On an initial clean-up on a new contract, all fixtures covered by the contract are checked for terminal voltage, defec-

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OPERATING ADVANTAGES

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Now include many improvements, one of which is the Telechron motor. Easy to install and set. Requires practically no service. Positively not affected by dust. Highest type of design and construction. Offered by progressive supply jobbers at generous trade discount. Write for Complete Catalog.

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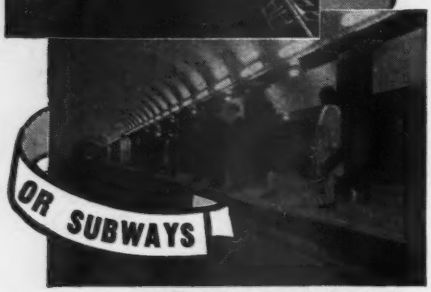


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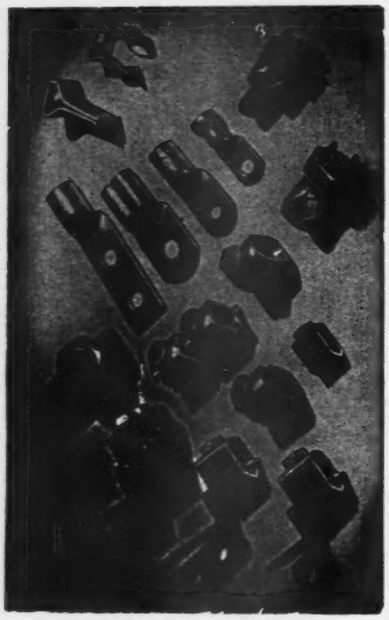

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tive lamps, starters, sockets, ballasts, and wiring inside the fixture. Any equipment found defective is put in perfect condition, and properly maintained for duration of the contract. Lamps are replaced prior to the life expectancy, so that maximum light output is maintained.

**Other Highlights**

With 18 months' experience in lighting maintenance service, The Jack Stone Company no longer limits its service to fluorescent lighting. It has already changed the name of the division to "Lighting and Maintenance Division". Contracts will now be entered into for maintenance of incandescent, fluorescent, hot cathode, cold cathode or mercury vapor lighting. These lighting maintenance specialists will now quote contract prices on maintenance of cove lighting, floodlighting, or other special types of lighting installations. Contracts for any type of special maintenance service will be considered, such as cleaning fixtures on a two month periodic schedule or on a more frequent basis.

Volume of business is the principal factor to insure financial success in maintenance service, in the opinion of Mr. Langston. Every effort should be made to establish high monthly billings as soon as possible. No profits can be expected from a new contract for the first six months. This makes it important to sign up all customers on a 24 month basis, where possible.

Mr. Langston offers the following seven factors as being of primary importance, if a fluorescent lighting maintenance service is to be put on a profitable basis:

1. Proper management.
2. Cooperation of customers.
3. Trained salesmen.
4. Specially trained mechanics.
5. Promptness in answering trouble calls
6. Adequately equipped rolling equipment.
7. Adequate supply of dependable materials.

Analysis of the operation of the Lighting and Maintenance Division of The Jack Stone Company leads one to the conclusion that it is is a successful operation, made so primarily due to hard work, careful planning, and full cooperation of all members of the organization. They have successfully lived through the trying period of getting established. They have barely dented the lighting maintenance market in their territory. They now have the organization, the know-how, and the trained personnel. The market is ready, and the prices are right. All factors point to continued growth and success.


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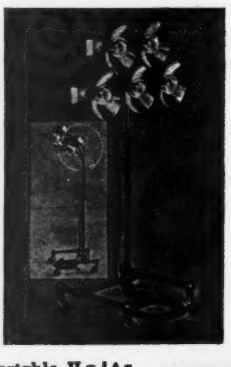
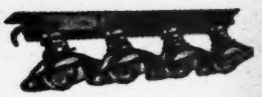


Portable Units, adjustable for height and angle, available in various lamp groupings.



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1044 Tyler St. St. Louis 6, Missouri

[FROM PAGE 55]

pact of increased light. Each bull pen is individually lighted by 18 - 1000-watt general service Mazda lamps operated at rated voltage, mounted 35 feet above the ground and housed in G. E. type L43 units.

The entire floodlighting system is operated from a remote control station located behind the Yankee dugout. The station consists of eight standard remote control three-position switches with indicating bulls eyes, the positions being trip - close - off and the red-green lights indicating whether the tower-riser circuit breakers are in an opened or closed position.

With co-owners Dan Topping and Del Webb, Larry MacPhail predicts that the 1946 season will mark the beginning of a golden era for sports which should produce the finest brand of baseball, the largest crowds and the greatest gate receipts in the history of the game. It is estimated through early-season attendance records that 95 million will watch baseball games during the season, 11 million will pay to see games played in the two major leagues and Big League gate receipts should exceed $20,000,000. Over two million fans will see the Yankees in action.

Club owners and managers, to hold the tremendous popular interest, attendances and profits, are offering sports fans the utmost in interest, comfort, convenience —and lighting. Floodlighting is bringing sports to masses of workers who formerly could witness afternoon contests only through absenteeism from their jobs. It also is improving playing conditions and the brand of baseball since players can work in the cool of the evening, in the absence of both glare and shadow.

***W. W. Tarrant, (right) owner and operator of the W. W. Tarrant Electric Machinery Company, Wichita, Kansas, checks progress on repairing of some REA distribution transformers. E. A. Lungwitz is the veteran winder.***


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ON
# FLUORESCENT LAMP BALLASTS

When a label is familiar to a buyer, it is usually because the organization so identified is long-established in its particular field.

Chicago Transformer ballasts can boast of three such labels—the C.T.C. emblem, a trademark of manufacturing experience, plus the U.L. and E.T.L. insignias, trademarks of two recognized testing laboratories.

**C. T. C.**—*Manufactured by Chicago Transformer.*
**U. L.** —*Approved by Underwriters Laboratories.*
**E. T. L.**—*Certified by Electrical Testing Laboratories.*

. . . Three labels to look for on fluorescent lamp ballasts, because ballasts bearing them win confidence for the lighting equipment in which they are installed.

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## REWINDING AND RECONNECTING A-C MOTORS

[FROM PAGE 61]

Where the change in frequency and number of poles results in the operation of the drive at a higher speed with increased horsepower requirements, such as in a pump or fan, a new impeller, new fan blades, or change of blade pitch may be considered to decrease the horsepower requirement of the drive to within the capacity of the motor at the new frequency.

*Example*—A single-phase blower motor, 0.25 hp., 1725 rpm., 120 volt, 60 cycle, with 24 stator slots, squirrel cage rotor, and split-phase starting winding is to be rewound to operate on a 120 volt, 25 cycle supply. Find the new number of turns on 25 cycles.

The synchronous speed of this 60 cycle motor having 4 poles is 1800 rpm. A similar winding with concentric coils is shown in Fig. 6a. The nearest 25 cycle synchronous speed is 1500 rpm. which requires 2 poles. Each solid line represents a running coil consisting of S turns which, in this case, may be assumed to be 40 turns.

1) *New horsepower rating.*—The horsepower rating of the 60 cycle motor on 25 cycles will be:

$$\text{Hp. } 25 = 0.25 \times (1500/1800) \times (0.94 \times 0.96) = 0.20$$

The new horsepower requirements of the blower will be (1500 x 0.94 / 1800 x 0.96)³ or about 54 percent of what it was at 60 cycles. The motor will therefore carry its blower load safely.

2) *Checking flux density in stator core.*—Whether the 60/25 increase in the stator core flux density per pole will be carried without undue core heating will depend on the original flux density in the core.

3) *Calculation of distribution factor.*—It is necessary to determine the distribution factor of the 60 cycle coils. The number of slots per pole is 24 slots / 4 poles = 6 which corresponds to 180 electrical degrees. Whether the winding is concentric or distributed, Table I below may be used to calculate the distribution factor. The distribution factor of the running winding is, as will be noted from Table I therefore, 3.23 S / 4 S = 0.808.

In laying out the 25 cycle winding, we may consider an arrangement similar to the one shown in Fig. 6b. In this 2-pole winding, full pitch will equal 24 slots / 2 poles or 12 slots where one slot will span 180/12 or 15 electrical degrees. T is assumed to be the number of turns per coil to be determined, gives a distribution factor of 6.57T / 8T = 0.821.

The number of turns per coil on the 25 cycle winding will be:

$$T = 40 \text{ turns} \times (60/25) \times (2 \text{ poles}/4 \text{ poles}) \times (0.808/0.821) = 47 \text{ turns}$$

The suggested procedure applies equally well to the starting winding which is shown in dotted lines.

5) and 6) *Calculation of magnet wire size and other changes.*—The calculation of the magnet wire size and the application of other changes may be worked out as described under their foregoing respective headings. Inasmuch as the new horsepower requirement of the drive is 0.14 hp. or 54 percent of what it was at the 60 cycle speed, another blade utilizing all of the 0.20 hp. may be used.

Next month we will conclude this series with a discussion of rewinding and reconnecting for changing the frequency of three phase motors.

TABLE I

| Coil pitch | Number of slots spanned | Equivalent electrical degrees: A | ½ A | Sin ½ A | Number of turns | Number of turns x Sin ½ A |
|---|---|---|---|---|---|---|
| 1 & 7 | 6 | 180 | 90 | 1.000 | S | S |
| 2 & 6 | 4 | 120 | 60 | 0.866 | 2 S | 1.73 S |
| 3 & 5 | 2 | 60 | 30 | 0.500 | S | 0.50 S |
| | | | | Total | 4 S | 3.23 S |

TABLE II

| Coil pitch | Number of slots spanned | Equivalent electrical degrees: A | ½ A | Sin ½ A | Number of turns | Number of turns x Sin ½A |
|---|---|---|---|---|---|---|
| 1 & 13 | 12 | 180 | 90 | 1.000 | T | T |
| 2 & 12 | 10 | 150 | 75 | 0.966 | 2 T | 1.93 T |
| 3 & 11 | 8 | 120 | 60 | 0.866 | 2 T | 1.73 T |
| 4 & 10 | 6 | 90 | 45 | 0.707 | 2 T | 1.41 T |
| 5 & 9 | 4 | 60 | 30 | 0.500 | T | 0.50 T |
| | | | | Total | 8 T | 6.57 T |

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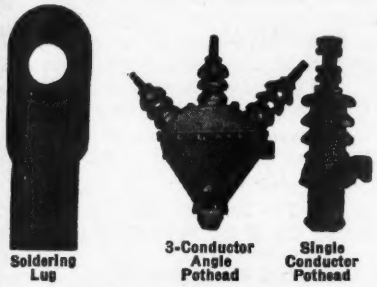

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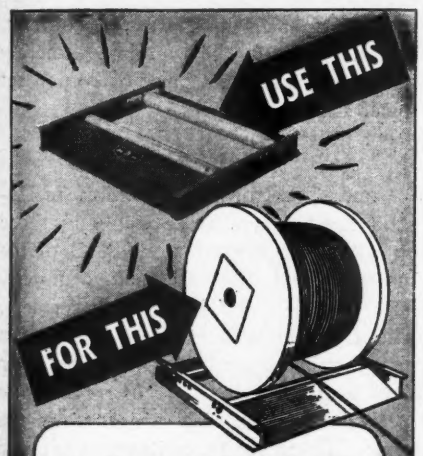


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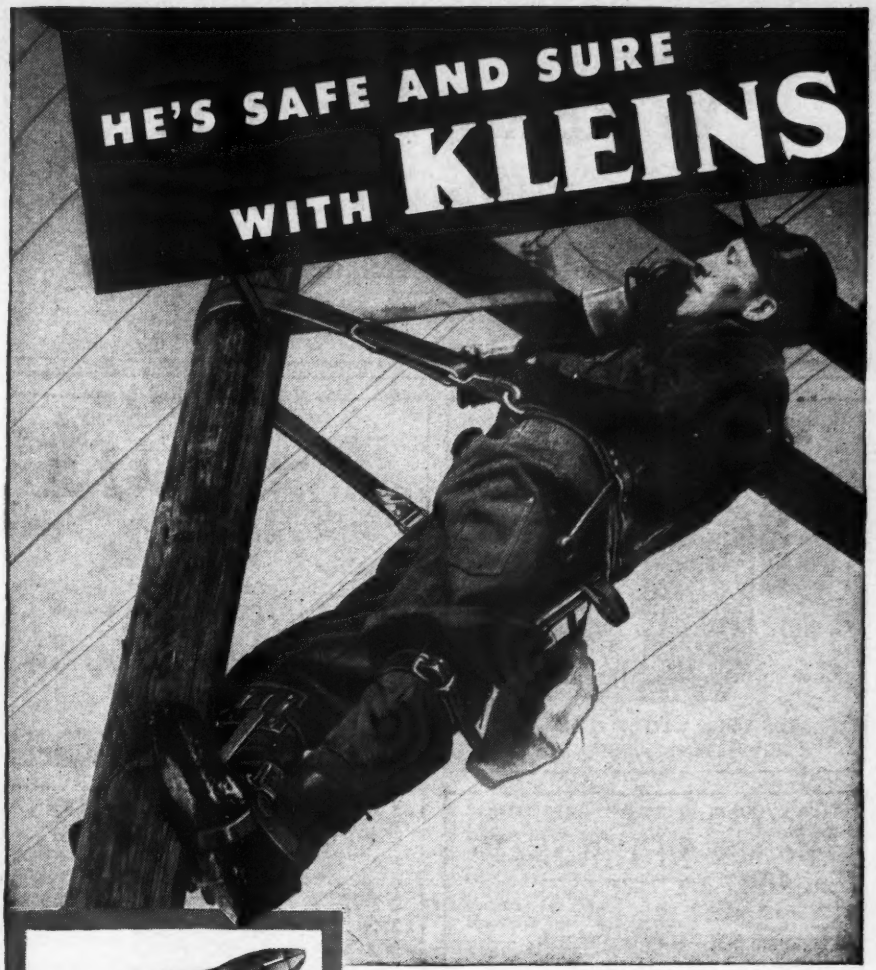

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Kirkland Bulls-I-Units are ideal for building lamp annunciators. Just provide the proper size holes in the panel, then insert the Kirkland units and lock into place. Assembly is then ready for installation. Connect incoming wires and place in service. *WRITE FOR CATALOGUE.*

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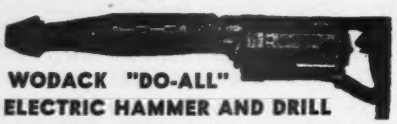

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supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation, maintenance and service. Make a habit of checking this page, each issue.

*DEPARTMENTAL STAFF*
ELECTRICAL CONTRACTING


## WHAT IS THE MARKUP?

[FROM PAGE 58]

*Example* 1 — **The "90–10" contract.**
**Using above figures for a 20 percent job overhead:**

| | | |
|---|---|---|
| **Material Markup** | **— 90 × 0.10 =** | **9.0 percent** |
| **Labor Markup** | **— 10 × 0.35 =** | **3.5 percent** |
| **Total Markup** | **—** | **12.5 percent** |

*Note: If Table of Multipliers for Overhead Adjustment were used the result could be determined by the simple calculation: 20 (normal job overhead) x 0.63 (table multiplier) = 12.6 percent.*

*Example* 2 — **The "20–80" Contract.**
**Using the above figures for a 20 percent job overhead:**

| | | |
|---|---|---|
| **Material Markup** | **— 20 × 0.10 =** | **2.0 percent** |
| **Labor Markup** | **— 80 × 0.35 =** | **28.0 percent** |
| **Total Markup** | **—** | **30.0 percent** |

*Note: If Table of Multipliers for Overhead Adjustment were used the result could be determined by the simple calculation: 20 (normal job overhead) x 1.50(multiplier) = 30 percent.*

A common markup of 20 percent would introduce an error of +7.5 percent on the "90–10" contract and a –10 percent on the "20–80" contract. In the first case the contractor would be reducing his chances of getting a contract, and in the second he would be gambling on getting a job at a price of 10 percent lower than he should.

### Installation-Only Projects

Contractors ordinarily think of Installation-Only projects as being those on which the owner supplies all of the material and the contractor supplies only the labor and installation services. This is not always the case. The owner may elect to supply all of the material or only a part of it. *In either case the method of estimating overhead is the same.* There are three items of expense to be figured:

(1) Expense in connection with materials supplied by others.

(2) Expense in connection with materials supplied by the contractor.

(3) Cost of the supply and management of labor.

The figures in Column II of Figure 1 show that normal overhead would be increased from 18 percent up to 100 percent on jobs with a "60–40" ratio, depending on the amount of the material supplied by others. To illustrate let's consider a specific example.

*Example:*
**An owner has a $10,000 "60–40" job and elects to buy $2 000 worth of the material.**

Being a "60–40" job, the total material would cost $6,000 and the labor cost would be $4,000. The *contract ratio* would be:

$$\frac{\$4{,}000 \text{ Material } (\$6{,}000 - \$2{,}000)}{\$4{,}000 \text{ Labor}} = \text{"50–50"}$$

Assume that the contractor's experienced overhead for Complete Installation of such work was 15 percent. According to Table II the overhead for this contract would be 18 percent above normal or $1.18 \times 15$ percent = 17.7 percent.

The markup would be computed as follows:

According to figures in previous tables, the cost of services in connection with materials supplied by the owner would be approximately 2½ percent. A 15 percent job overhead represents approximately 7.5 percent on material and 26.5 percent on labor.

*Calculations:*

| | |
|---|---|
| Material by owner — $2,000 × 0.025 = | $50.00 |
| Material by contractor — $4,000 × 0.075 = | 300.00 |
| Labor by contractor — $4,000 × 0.265 = | 1,060.00 |
| Total OH Cost | —$1,410.00 |

The contractor's base cost would be $4,000 for material and $4,000 for labor; a total of $8,000. With an overhead cost of $1,410, the percentage of overhead would be:

$$\frac{\$1{,}410}{\$8{,}000} = 0.1763 = 17.63 \text{ percent}$$

$$\frac{\text{Adjusted OH}}{\text{Normal OH}} = \frac{17.63 \text{ percent}}{15 \text{ percent}} =$$

1.176 = 1.18 (multiplier to be used)

If the owner elected to supply all the materials, the *contract ratio* would be "0–100" and the multiplier would be "2.0"

With a multiplier of 2.0, the adjusted OH would be $2.0 \times 15 = 30$ percent.

*Calculations:*

| | |
|---|---|
| Material by owner — $6,000 × 0.025 = | $150.00 |
| Material by contractor — ——— ——— = | ——— |
| Labor by contractor — $4,000 × 0.265 = | 1,060.00 |
| Total OH Expense | = $1,210.00 |

$$\text{Contract OH} = \frac{\$1{,}210}{\$4{,}000} = 0.3025 = 30.25 \text{ percent}$$

$$\frac{\text{Adjusted OH}}{\text{Normal OH}} = \frac{30.25}{15} = 2.016 =$$

2.0 (Multiplier to be used)

One more example will serve two purposes.

(1) It will again emphasize the point that the foregoing figures are only to illustrate methods of establishing overhead.

(2) It will answer the oft asked question: "Should the adjusted overhead be applied to the excess labor created by procurement failures (material by others) and other "Installation-Only" hazards?"

In addition to the material and labor items of expense previously considered, the completed estimate will contain such other items. Special items should have (labor above normal due to procurement failures, etc.), job costs, and possibly other items. Special items should have

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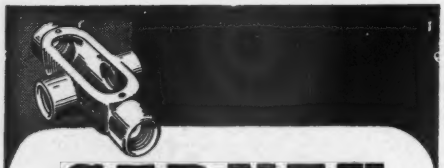

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a markup based on the estimator's experience and judgment.

To *accurately* establish the total markup on excess labor charges, the conventional method of estimating should be used. For all *practical* purposes, however, the multipliers shown in the tables can be used even though they do introduce a slight error. This is due to the fact that the multipliers were developed on the basis of a "60–40" job ratio. Actually, the addition of excess labor throws the normal "60–40" *job ratio* slightly out of balance. For instance: The addition of five percent excess labor to a normal "60–40" job (material—$6,000, labor—$4,000) would jump the labor to a $4,200 total. The *job ratio* would then be "58.8 – 41.2."

The following examples (for a normal $10,000 job—$6,000 material, $4,000 labor) show the slight difference in results obtained when using the two methods of markup:

*Example* 1 — *Conventional Method*

**The following calculations are based on an assumed experience job overhead of 15 percent (for Complete Installation—all material furnished by contractor) which represents approximately a 26.5 percent markup on labor and 7.5 percent on material furnished by the contractor.**

| | |
|---|---|
| **Estimated *Normal* Labor — $4,000 × 0.265 =** | **$1,060.00** |
| **Estimated *Excess* Labor (5%) — $200 × 0.265 =** | **53.00** |
| **Material Service (all material furnished by owner) — $6,000 × 0.025 =** | **150.00** |
| **Total Labor Overhead (including material service)** | **$1,263.00←** |

*Example* 2 — *Using Multipliers*

**Based on the assumed 15 percent experience job overhead as above and using the table multiplier for the "0–100" *contract ratio.***

| | |
|---|---|
| **Estimated *Normal* Labor** | **—$4,000.00** |
| **Estimated *Excess* Labor (5%)** | **— 200.00** |
| **Estimated Total Labor (Base Labor Cost)** | **$4,200.000** |

**Percentage Markup = 15 (normal experience OH) × 2 (multiplier) = 30 percent**

**Total Labor Overhead (including material service) = $4,200.00 (Base Labor Cost) × 0.30 = $1,260.00←**

The $3.00 error illustrated above should be of slight concern.

Every electrical installation is custom built and an overhead percentage has to be designed to fit. Only general rules can be formulated for governing such designs; the details are something which must be established by the estimator.

In estimating overhead and operating costs, as in estimating labor, one can not hope to be 100 percent correct. Every contractor, however, owes it to himself, his organization, and the electrical contracting industry, to become as proficient as possible in this phase of his business.

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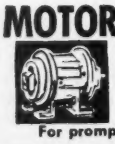

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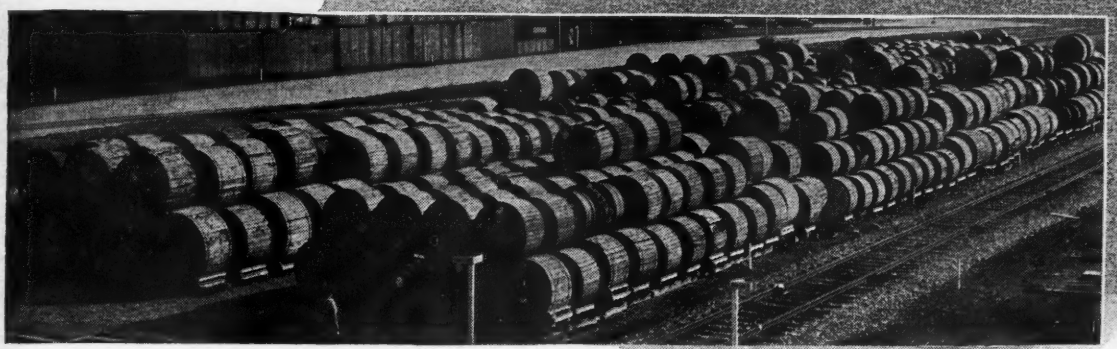

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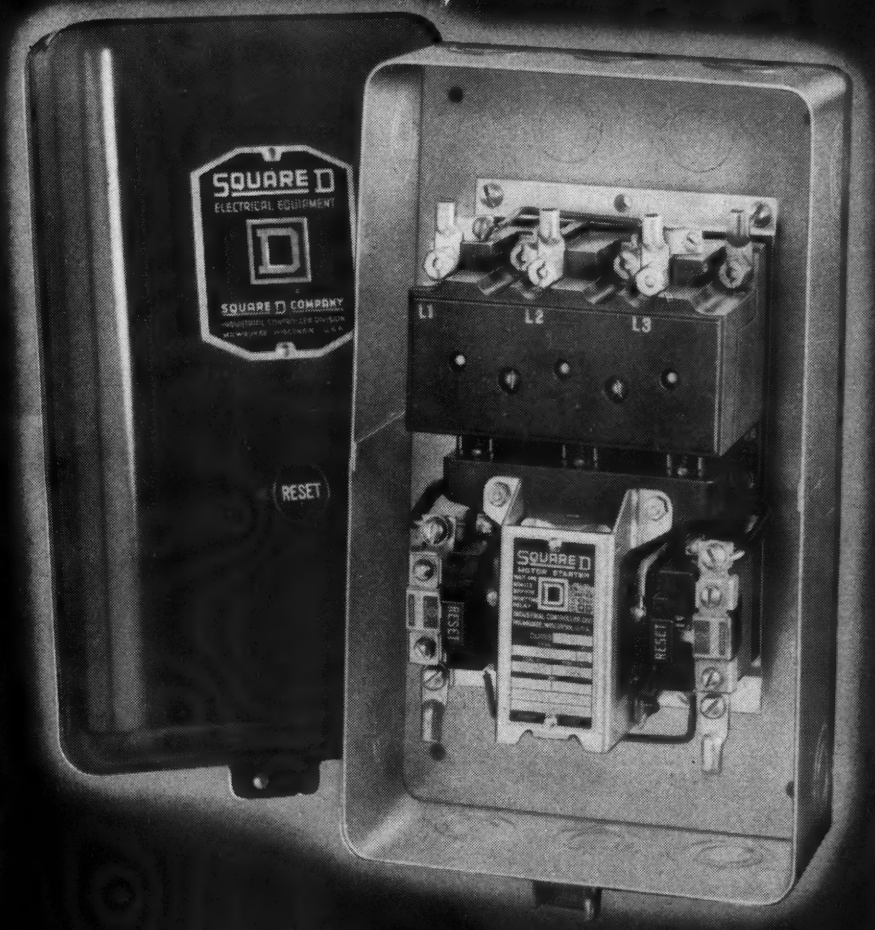


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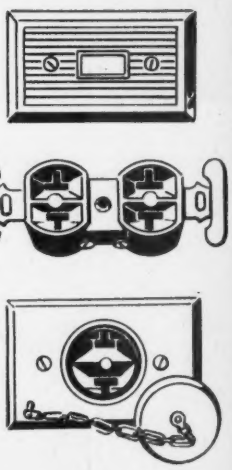

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